

THE LARVAE OF SOME AUSTRALIAN AQUATIC HYDROPHILIDAE (COLEOPTERA: INSECTA)

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The larvae of the aquatic Hydrophilid genera *Allocotocerus* Kraatz, *Hybograllius* Orchymont and *Regimbartia* Zaitzev are described and figured for the first time. The larvae of the following Australian species are also described and figured, most for the first time: *Allocotocerus punctatus* (Blackburn); *Amphiops queenslandicus* Balfour-Browne; *Berosus australiae* Mulsant; *Enochrus eyrensis* (Blackburn), *E. mastersi* (W. MacLeay); *Helochares tristis* (W. MacLeay), *H. luridus* (W. MacLeay), *H. clypeatus* (Blackburn), *H. tenuistriatus* Regimbart, *H. foveicollis* (Montrouzier); *Hydrobiomorpha* sp.; *Hydrophilus bilineatus* (MacLeay); *Hybograllius hartmeyer* (Regimbart); *Laccobius decipiens* Gentili; *Limnoxenus zealandicus* (Broun); *Regimbartia attenuata* (Fabricius); and *Sternolophus marginicollis* (Hope).

The larvae were identified by rearing larvae collected in the field, or occasionally by association and elimination, or by using biochemical methods.

The pupae of *Amphiops queenslandicus* and *Hybograllius hartmeyer* are described and figured. Unlike most other Hydrophilids the larvae of *Amphiops* are thought to pupate exposed on the stems of emergent vegetation.

A key is provided to the larvae of Australian genera of aquatic Hydrophilids other than *Notohydrus* Balfour-Browne, *Paranacaena* Blackburn, *Phelea* Hanson and *Agraphydrus* Regimbart, whose larvae remain unknown.

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The Hydrophilidae (sensu Hansen 1991) comprise a major part of the Australian aquatic beetle fauna, occurring in all types of fresh water and most commonly among vegetation at the edge of standing water. Adults and larvae occur together. The taxonomy of the adults is now relatively well known thanks to the work of Hansen (1991) at the generic level and above; and that of Gentili (1980, 1992, 1993, 2000) and Watts (1987, 1988, 1989, 1990, 1995, 1998a, 1998b) on the aquatic fauna at the species level. No recent work has been done on the species level taxonomy of the extensive portion of the family in which both adults and larvae are terrestrial.

In contrast to the situation with adults, the only work specifically on Australian larvae is that of Anderson (1976) who described the larvae of *Helochares tristis* (W. MacLeay), *Enochrus maculiceps* (W. MacLeay) and *Chasmogenus nitescens* (Fauvel) together with details of their life histories.

One feature of the Australian aquatic Hydrophilid fauna is its low endemism at the generic level. Consequently, descriptions of a

number of Australian genera are available in scattered Northern Hemisphere publications. The work on the New World genera was summarised and added to by Archangelsky (1997). This work included a number of genera which also occur in Australia.

For a number of years I have been rearing field-collected larvae of Australian aquatic Hydrophilids with the aim of discovering and describing the larvae of all genera and, for those already known from non-Australian species, to extend the descriptions to incorporate Australian species. The basic motivation was to produce a key to enable the larvae of all Australian aquatic Hydrophilidae to be identified at least to genus. As a result I have reared 12 species in 9 genera. Two additional genera, *Allocotocerus* and *Regimbartia*, were identified by associating adults and larvae by the biochemical technique of alloenzyme electrophoresis. Others were identified using the descriptions in Archangelsky (1997), eg *Hydrobiomorpha*; or by association and elimination, eg *Enochrus mastersi*.

I have not attempted any phylogenetic analysis

since, with such a high proportion of genera also occurring widely outside Australia, the only sensible approach would have been to include an examination of all known genera, which was beyond the scope of this study. Some comments on relationships are given under most generic descriptions.

In preparing this paper I have drawn heavily on the work of Archangelsky (1997) on the New World fauna. The descriptions follow his format and a number of the figures used to illustrate the key come from his important publication.

Although their larvae are known from other places, I have not seen Australian examples of the following genera: *Chaetarthria* Stephens, *Chasmogenus* Sharp, *Crenitis* Bedel, *Coelostoma* Brulle or *Paracymus* Thomson, and since I have nothing to add have not included descriptions. Detailed descriptions can be found in Archangelsky (1997). In addition, the larvae of *Paranacaena* Blackburn, *Notohydrus* Balfour-Browne, *Phelea* Hanson and *Agraphydrus* Regimbart are unknown.

MATERIALS AND METHODS

Larvae were collected in the field and reared in small aquaria formed by placing the base of a small petrie-dish inside a larger petrie-dish and filling the space between them with damp sand (Watts 1963). Mosquito and chironomid larvae were the main food items provided. These were accepted by all larvae other than those of *Hydrophilus* (see under *Hydrophilus*). All species successfully reared pupated in cells constructed in the wet sand with the exception of those of *Amphiops* which pupated on the surface or attached to the sides of the container.

Larvae were preserved in 75% ethanol and examined under a stereomicroscope. Permanent microscope slides were prepared for detailed examination. Drawings were made with the aid of a camera lucida. Habitus drawings were only prepared when no previous illustration was available or when Australian species differed from those previously illustrated. Unless otherwise mentioned the descriptions are based on third instar larvae. Earlier instars usually differ somewhat, most noticeably in the stouter cephalic appendages and in fewer spines on the mentum. The key is constructed to accommodate all instars. Measurements of the head capsule were made under a stereoscopic microscope with a graduated eyepiece. Measurements of total

length were made with dial callipers on both mounted and alcohol preserved material, but in this case the measurements can only be indicative as factors such as larval age and preservation effects can alter the length considerably. Measurements of the head capsule, particularly the width, are a more reliable indicator of size. Unless stated otherwise, the specimens were collected by myself and are in the collection of the South Australian Museum.

SYSTEMATICS

KEY TO THE GENERA OF AUSTRALIAN AQUATIC HYDROPHILIDAE BASED ON LARVAL CHARACTERS

- 1) Not including the genera *Notohydrus*, *Paranacaena*, *Phelea* and *Agraphydrus*, whose larvae are not known.
- 2) Including *Spercheus* which is in the family Spercheidae but which has larvae that can be confused with Hydrophilidae.
 - 1 — Tip of mandible bifid (Fig. 2g) Spercheidae (*Spercheus*)
 - Tip of mandible not bifid Hydrophilidae...2
- 2 — Hypopharyngeal lobe well developed, like a pubescent tongue, originating at the base of the labium on the left side (Figs 2a, 2b) Subfamily Sphaeridiinae* *Coelostoma* Brulle
 - Hypopharyngeal lobe reduced or absent Subfamily Hydrophilinae...3
- 3 — Abdominal segments with long filamentous gills (Fig. 5a), or with multiple setose lateral projections on abdominal and thoracic segments (Fig. 15a) Tribe Berosini...4
 - Lacking long filamentous abdominal gills or complex lateral projections, at most with simple short fleshy projections (Figs 4a, 14a, 16a) 6
- 4 — Gills long, without setae (Fig. 5a); labroclypeus asymmetric (Fig. 5b); mandibles asymmetric (Fig. 5f); prementum small and squat, without ligula (Fig. 5c), basal segment of antenna without lateral projection (Fig. 5e) *Berosus* Leach
 - Abdominal and thoracic segments each with two or more setose, lateral projections

- (Fig. 15a); mandibles nearly symmetrical (Fig. 15h); prementum long and thin, with ligula (Fig. 15d); basal segment of antenna with lateral projection (Fig. 15g) 5
- 5 — Body spines predominantly blunt, weakly bifid at tips (Fig. 3b); lateral projection on basal segment of antenna near apex, sharp, spine-like (Fig. 3f); apex of second segment of antenna with lateral extension (Fig. 3d); maxillary stipe without spines (Fig. 3e); ligula relatively short, prementum stouter (Fig. 3c) *Allocotocerus* Kraatz
- Body spines predominantly pointed (Fig. 15c); lateral projection on basal segment of antenna thumb-like, further from apex (Fig. 15g), second segment of antenna without lateral extension (Fig. 15e); maxillary stipe with spines on inside (Fig. 15f); ligula relatively long, prementum more elongate (Fig. 15d) *Regimbartia* Zaitzev
- 6 — Apical segment of antenna about same length as penultimate (Figs 12d, 16e); femora with fringe of swimming-hairs (Fig. 2h); with prostyles (two retractable, fleshy appendages on last abdominal segment) Subtribe *Hydrophilina*... 7
- Apical segment of antenna much shorter than penultimate (Figs 9e, 14e); femora lacking, or virtually lacking, swimming-hairs; without prostyles 9
- 7 — Labroclypeus without teeth (Fig. 12a); mandibles asymmetrical, left one very robust, right one more slender (Fig. 12e); ligula shorter than first segment of labial palpus (Fig. 12b); up to 40 mm long *Hydrophilus* Muller
- Labroclypeus with weak to moderate teeth (old specimens may lack teeth due to wear) (Figs 11e, 16f); mandibles symmetrical or nearly so; ligula longer than first segment of labial palpus (Figs 11b, 16c); up to 20 mm long 8
- 8 — Prementum longer than mentum (Fig. 16c); first segment of antennae with few spines (Fig. 16f); mandibles each with two large distal teeth and one small proximal denticle (Fig. 16f) *Sternolophus* Solier
- Prementum slightly shorter than mentum (Fig. 11b); first segment of antenna with numerous spines on inside (Fig. 11c); mandibles each with one large distal tooth which is pick-shaped at the tip and one or two small proximal denticles (Fig. 11e) *Hydrobiomorpha* Blackburn
- 9 — Left expansion of epistoma much more prominent than the right and with a row of stout setae on front edge (Fig. 13b); left mandible with group of stout setae at base of middle tooth which is lacking on the right mandible (Fig. 13f) 10
- Lateral expansions of epistoma similar, without a row of stout setae on front edge (Fig. 14b); mandibles without such a group of setae 11
- 10 — Frontal sulci parallel and not uniting to form a coronal sulcus (Fig. 13a); nasale with three teeth (Fig. 13b); prementum wider than long (Fig 13c); ligula absent or virtually so (Fig. 13c) *Laccobius* Erichson
- Frontal sulci meet just before occipital foramen to form a coronal sulcus (Fig. 10a); nasale with five teeth (Fig. 10b); prementum longer than wide (Fig. 10c); ligula present though small (Fig. 10c) .. *Hybogralius* Orchymont
- 11 — Legs very short, without claws, prementum with a large round ligula (Fig. 2e); length up to 6 mm *Chaetarthria* Stephens
- Legs usually longer, with claws. Prementum with or without ligula, but if present never large and round; length up to 15 mm 12
- 12 — Mentum large, wider than long, prementum small, lacking ligula (Fig. 4b) *Amphiops* Erichson
- Mentum square or longer than wide, prementum well developed, ligula present (Figs 6b, 8b, 14c) 13
- 13 — All abdominal segments with dorsal sclerites, although often small; without coronal sulcus (Fig. 2c); length up to 6 mm; antennal appendage as long as apical segment; mandibles symmetrical with three teeth Tribe *Anacaenini*... 14
- Abdominal segments, other than 1 and 8, lacking dorsal sclerites; with short coronal sulcus (Fig. 1a); antennal appendage half length of apical segment (Fig. 8d); mandibles often asymmetrical and with fewer than three teeth; length up to 15 mm 15
- 14 — With lateral abdominal flaps (Fig. 2c); without cervical sclerites *Crenitis* Bedel

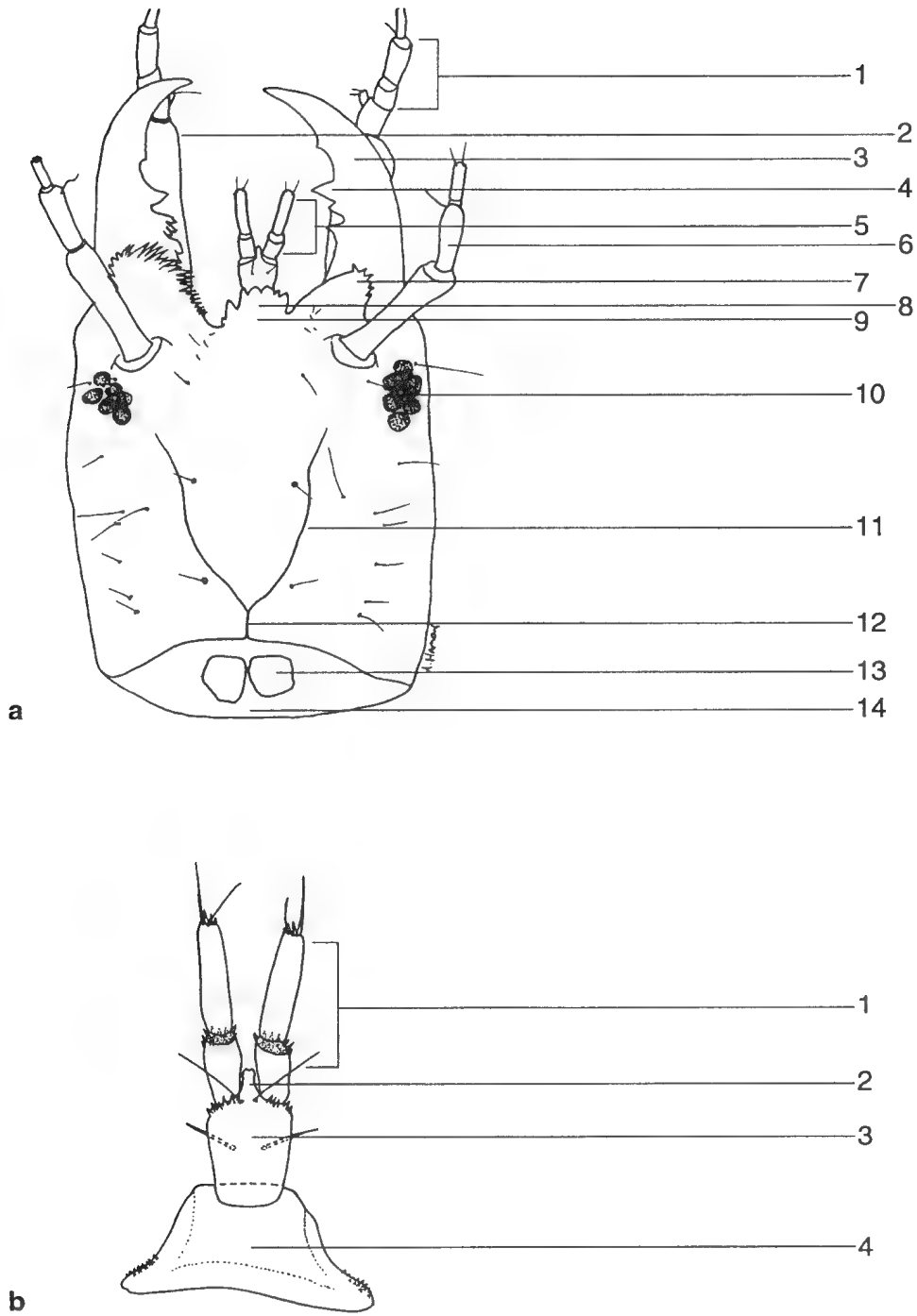


FIGURE 1. a, dorsal side of head capsule of *Hybogralius hartmeyer*. 1, maxillary palpus; 2, stipes of maxillary palpus; 3, mandible; 4, mandibular teeth; 5, labium; 6, antenna; 7, right lobe of epistome; 8, teeth of nasale; 9, nasale (7 & 9 make up the labroclypeus); 10, stemmata; 11, frontal sulci; 12, coronal sulcus; 13, cervical sclerites; 14, occipital foramen; b, details of dorsal side of labium of *Hybogralius hartmeyer*. 1, labial palpus; 2, ligula; 3, prementum; 4, mentum.

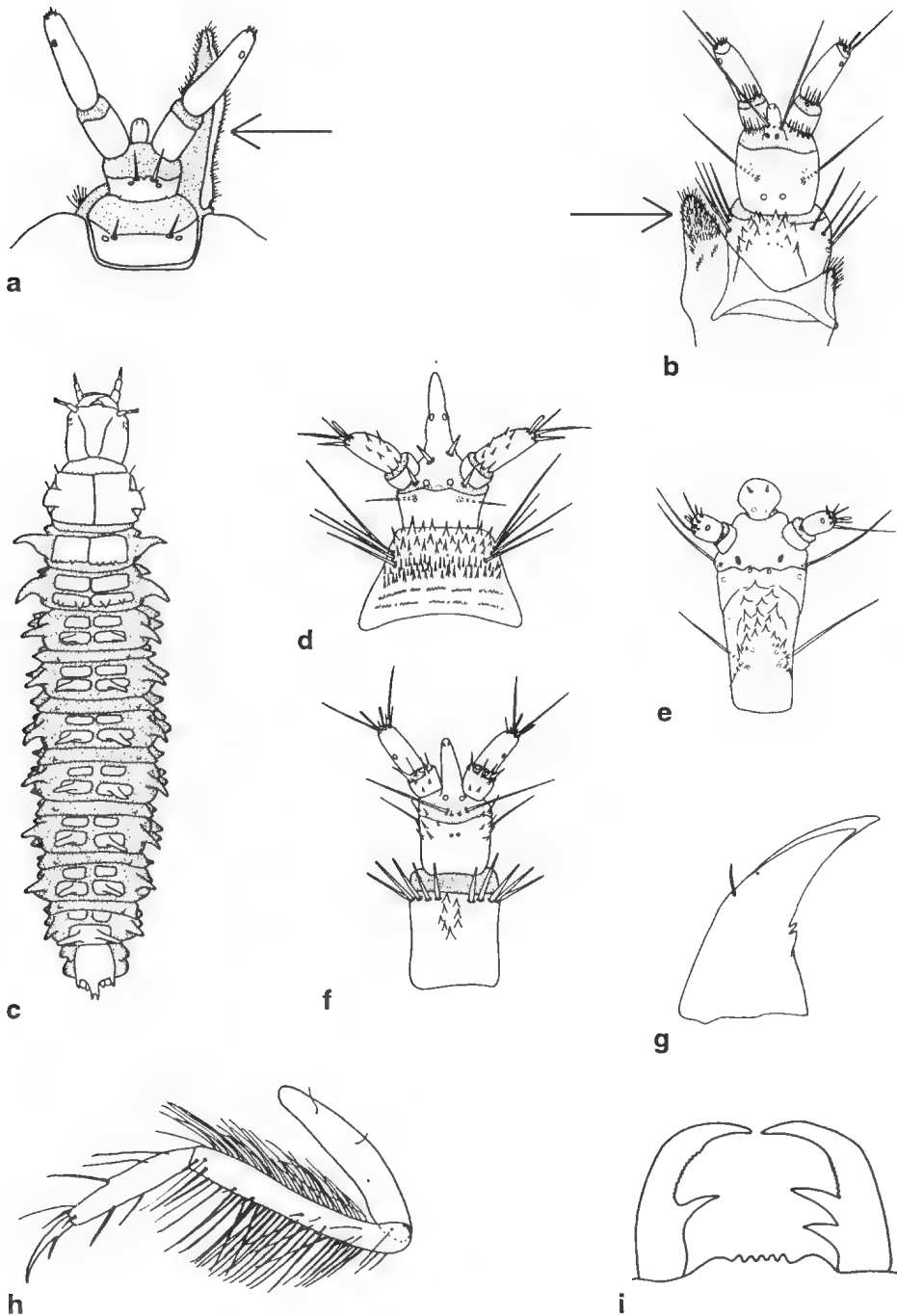


FIGURE 2. a, ventral view of labium and hypopharyngeal lobe (arrowed) of *Sphaeridium scarabaeoides* (Linnaeus) (subfamily Sphaeridiinae); b, dorsal view of labium and hypopharyngeal lobe (arrowed) of *Dactylosternum* sp. (subfamily Sphaeridiinae); c, habitus of *Crenitis morata* (Horn); d, ditto, dorsal view of labium; e, ditto of *Chaetarhria* sp.; f, ditto, *Paracymus subcupreus* (Say); g, mandible of *Spercheus platycephalus* MacLeay; h, hindleg of *Hydrobiomorpha* sp., Northern Territory; i, labroclypeus and mandible of *Chasmogenus nitescens* (Fauvel). a–f, North American taxa from Archangelsky 1997; i, from Anderson 1976.

- Lacking abdominal flaps; with small cervical sclerites. *Paracymus* Thomson
 - 15 — Apical segment of antenna about half length of penultimate (Fig. 14e); mandibles symmetrical with three teeth, without serrations (Fig. 14f)
..... *Limnoxenus* Motschulsky
 - Apical segment of antenna about a quarter the length of the penultimate segment (Fig. 8d); mandibles weakly to strongly asymmetric, with one or two teeth, often with serrations (Figs 6e, 8e)
..... Subtribe Acidocerenia....16
 - 16 — Nasale moderately developed, with right side more prominent (Fig. 6a) 17
 - Nasale poorly developed, all areas equally prominent (Fig. 9b) 19
 - 17 — Mandibles asymmetric, the right one with one tooth, left with two (Fig. 6e) *Enochrus* Thomson (other than *E. mastersi*)
 - Mandibles almost symmetrical, both with two teeth (Fig. 8e) 18
 - 18 — Inside of maxillary stipe with group of spines near base (Fig. 8c); ligula longer than first segment of labial palpus (Fig. 8b); prementum approximately the same length as mentum (Fig. 8b)....*Helochares* Mulsant (other than *H. foveicollis*)
 - Inside of maxillary stipe lacking such spines (Fig. 7c); ligula shorter than first segment of labial palpus (Fig. 7b); prementum approximately twice length of mentum (Fig. 7b)
..... *E. mastersi* (W. MacLeay)
 - 19 — First segment of antenna with bulge on inside near apex (Fig. 9e); mandibles each with two teeth (Fig. 8f)
..... *H. foveicollis* (Montrouzier)
 - First segment of antenna without bulge; right mandible with one tooth, left one with two (Fig. 2i)
..... *Chasmogenus* Sharp
- * Members of the subfamily Sphaeridiinae are predominantly terrestrial, occurring in moist situations such as dung and rotting vegetation. Members of only one genus, *Coelostoma*, are commonly found in aquatic situations in Australia.

DESCRIPTIONS

The following descriptions are arranged in alphabetic order of the genera.

Allocotocerus Kraatz*Allocotocerus punctatus* (Blackburn) Fig. 3

Size of third instar. Length 8.5–12.0 mm; head capsule, 0.70–1.00 mm long, 0.85–1.0 mm wide.

Head capsule. Subquadrangular, bulging outwards at anterolateral angles. Labroclypeus symmetrical; nasale very short, with numerous very short teeth on anterior border of epistome; lateral lobes of epistome rounded, very short. Frontal sulci straight, reaching from antennal bases to rear of head. Coronal sulcus absent. Gular sclerite absent. Cervical sclerites small, subrectangular, very weakly sclerotised.

Antennae. Three-segmented. First segment slender, longer than other two combined, with a spine-like inner process close to apex; third antennal segment short, connected to edge of the second segment before apex. Sensory appendage on second segment, slim, shorter than third segment.

Mandibles. Symmetrical, long and slender, with two inner teeth on basal half; distal tooth large, basal one small.

Maxillae. Five-segmented. Stipes slender, much longer than remaining segments combined, with two or three fine setae on inner margin. Palpus four-segmented; first and third segments subequal in length, first segment bearing a short inner process; second segment very short; fourth segment shorter than third.

Labium. Mentum large, subglobular, dorsal surface with some cuticular spines towards sides, anterolateral angles rounded with a few spines. Prementum much longer and narrower than mentum, subrectangular, longer than wide. Palpus two-segmented, basal segment short. Ligula about two times as long as basal segment of palpus, tip broadened.

Thorax and legs. Prothorax with broad dorsal sclerite, with sagittal line, surface covered by minute spines, fringe of long, slender setae around the margins and three short setae-bearing projections at sides; ventral surface with large, subrectangular sclerite, without sagittal line. Mesothorax with two dorsal pairs of subtriangular sclerites. Metathorax with one dorsal pair of irregular shaped sclerites. Both mesothorax and

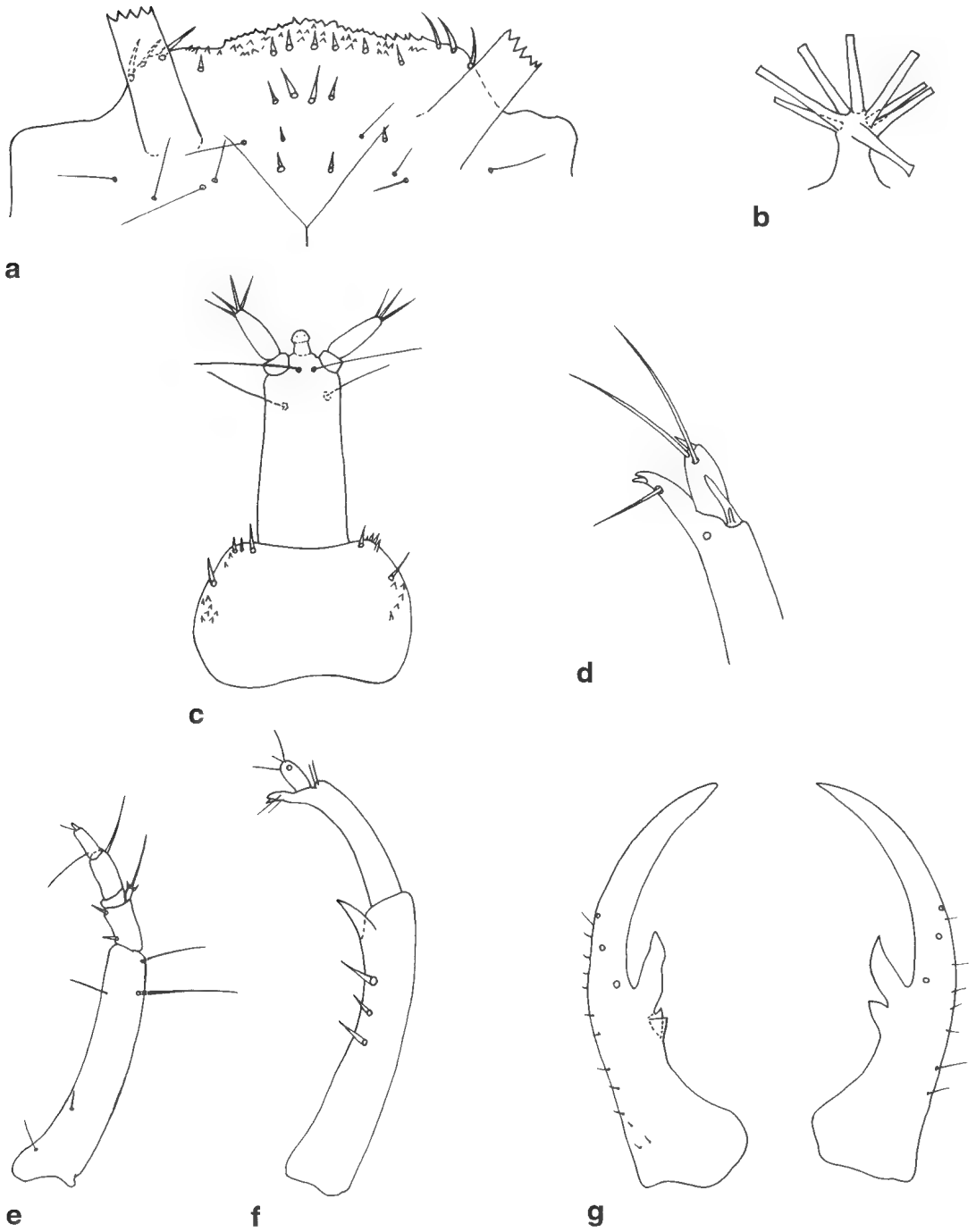


FIGURE 3. *Allocotocerus punctatus*. a, labroclypeus; b, detail of abdominal stella; c, labium; d, tip of antenna; e, maxilla; f, antenna; g, mandibles.

metathorax with three lateral pairs of setiferous projections and a number of short setiferous papillae on dorsal surface. Legs five-segmented, long, visible from above.

Abdomen. Segments 1 to 7 with four pairs of setiferous projections similar to those on thorax, three on the side and a smaller dorsal one towards the midline. In addition, the abdomen is covered with minute, simple spines and the dorsal surface with small projections, each with six to eight, relatively long setae, truncated or weakly bifid at tips (in most specimens these structures are obscured by an accumulation of sand grains and detritus). Segment 8 without setiferous projections; with dorsal semispherical sclerite covering the spiracular atrium; with a pair of small finger-like 'procerci'. Segment 9 trilobed, with a pair of small, unsegmented urogomphi.

Spiracles. Mesothorax and abdominal segment 2 with pair of small non-functional spiracles on short papillae. (I have been unable to detect spiracles on other abdominal segments.) Spiracles on segment 8 annular, large and functional, within the spiracular atrium.

Interspecific variation

There is little variation among the few specimens seen — including one from the Northern Territory which is almost certainly *A. tibialis* (Balfour-Browne).

Identification

By association of adult and larva by isoenzyme electrophoresis.

Remarks

The larvae closely resemble those of the New World genus *Derallus* (Archangelsky 1997; Spangler 1966) in the setiferous body structures, form of the labroclypeus, mandibles, labium, maxillary palpi and antennae. The differences are small: blunt rather than sharp-pointed body spines, shape of the distal part of the antennae, number of spines on the maxillary palpi and details of the labium. The larva of *Allocotocerus* is also closely similar to those of *Regimbartia*, differing from this genus in the details of the same suite of characters. On balance it more closely resembles *Derallus*. Although placed by Hansen (1991) with *Berosus* in the tribe Berosini, on larval characters the three genera form a very distinctive and cohesive group well separated from *Berosus*, a conclusion reached by others (Bertrand 1972; Oliva 1992; Spangler 1966).

Specimens examined

Queensland: 2 km S Mt Molloy, 30/3/96. *Allocotocerus* sp. **Northern Territory:** Manton Dam, 23/3/98.

Amphiops Erichson

Amphiops queenslandicus Balfour-Browne. Figs 4, 17a

Size of third instar. Length 6.5–9.0 mm; head capsule 0.65–0.80 mm long, 0.78–0.82 mm wide.

Head capsule. Subquadrate. Labroclypeus symmetrical; nasale very short, with five small teeth; lateral lobes of epistome rounded, projecting further than nasale. Frontal sulci inversely bell-shaped, meeting before reaching occipital foramen. Coronal sulci very short. Gular sclerite absent. Cervical sclerites small, rectangular.

Antennae. Three-segmented. First segment as long as second; third half the length of second. Sensory appendage on second segment short, a quarter the length of the third segment.

Mandibles. Symmetrical with three inner teeth, the two distal teeth large and with slightly crotchet-shaped tips; third tooth much smaller.

Maxillae. Five-segmented. Stipes narrow, longer than the remaining segments combined, with a row of five to six small setae on inner margin. Palpus four-segmented; first segment elongate, rectangular, with inner process as long as very short second segment; third segment longer and narrower than first; fourth segment a little longer than second.

Labium. Mentum large, subrectangular, anterior edge with five to six large spines/protuberances, and numerous cuticular spines at sides towards base. Prementum ovoid, much smaller than submentum. Palpus short, two-segmented, basal very short, distal segment two to three times longer than basal one. Ligula absent.

Thorax and legs. Pro-, meso- and metasterna, almost completely covered by dorsal sclerites, each with a sagittal line. Ventral surface of prothorax with a subrectangular sclerite, subdivided by a sagittal line. Sclerites with very small spines arranged in short lines towards rear (only visible under high magnification). Bases of setae on sclerites pigmented. Legs five-segmented, moderately developed, visible in dorsal view. Dorsal surface with sparse covering of small dark patches.

Abdomen. First segment with dorsal pair of

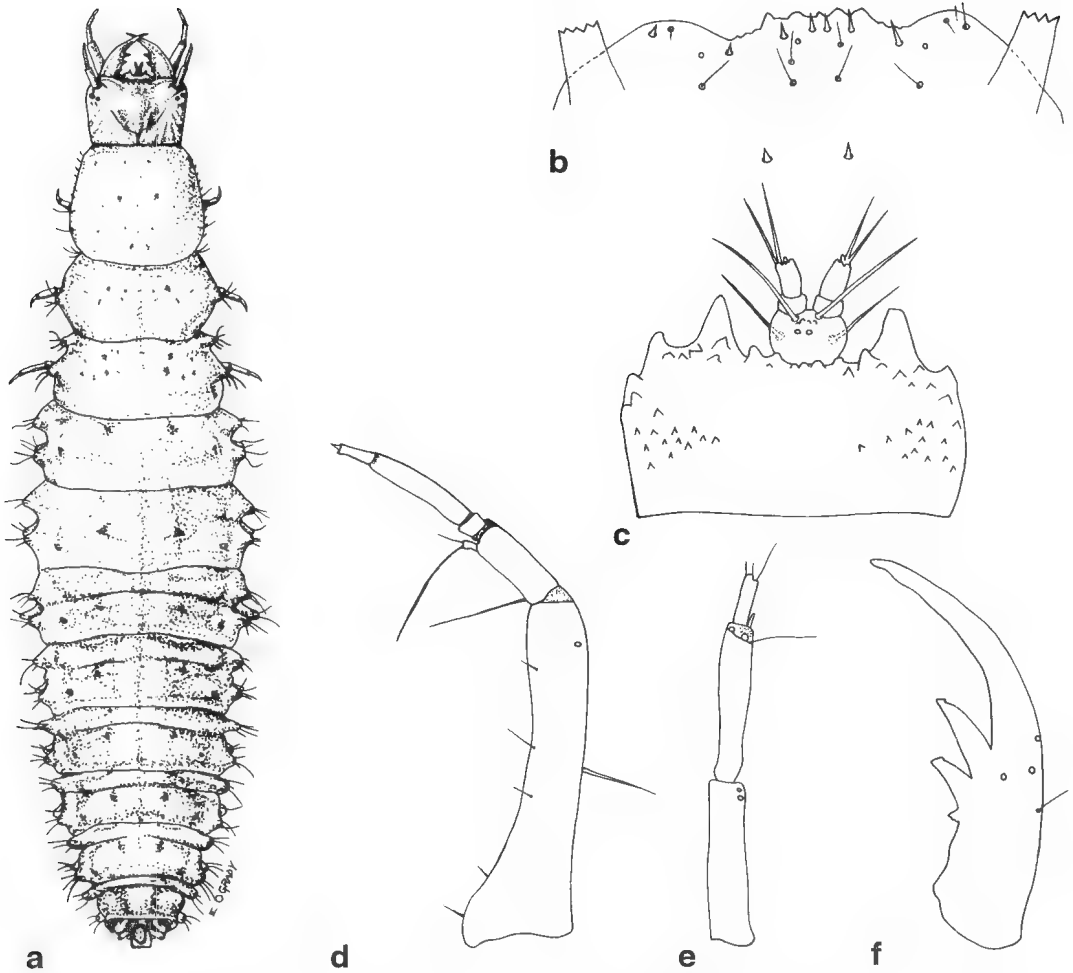


FIGURE 4. *Amphips queenslandicus*. a, habitus; b, labroclypeus; c, labium; d, maxilla; e, antenna; f, mandible.

moderate sized subtriangular sclerites, segments 2 to 5 with smaller dorsal sclerites, sclerites with scattered small darker patches. Segments 1 to 7 similar in size and shape, subdivided by a transverse fold; pleural areas with four pairs of moderate bulges/lobes each with several long setae at apex, ventral one largest; with a pair of small dorsal papillae, each with long terminal setae, abdominal surface strongly folded. Segment 8 with pair of small 'procerci', with a large dorsal, suboval sclerite; segment 9 trilobed, with a pair of small one-segmented urogomphi. Integument with only a few small spines.

Spiracles. Eight abdominal pairs; pairs 1 to 7 non-functional, on tips of small papillae and each with a

long seta immediately inwards on a small cylinder-shaped base. Spiracles on segment 8 annular, large and functional, within the spiracular atrium.

Pupa. (Fig. 17a)

Colour. Light to dark brown.

Head. With one pair of supraorbital styli; styli without apical setae. Appendages adpressed tightly to body, weakly differentiated externally.

Thorax. Pronotum with 16 styli, all on margins of pronotum. Mesothorax lacking obvious styli; metanotum with two pairs of styli, lateral ones near the base of wingpads very small, central pair prominent. Styli without setae. Wing cases grooved/ridged. Legs held tightly against body almost totally covered by pterothecae.

Abdomen. Segments 1 to 7 with a transverse row of four to five very small tergal styli on a sharp ridge that is stronger laterally. Segments 1 to 7 with well-developed rigid flap-like lateral extensions, those on segments 1 to 3 upright and slightly bent over inwards, those on segments 4 to 7 horizontal and each with a small stylus on posterior edge, each stylus with a small seta. Anterior edge of first tergite with very prominent, thin, rigid ridge. Segment 8 without obvious styli; segment 9 bearing a pair of medium-sized cerci.

Interspecific variation

There is little variation among the specimens of *Amphiops* available, although it is almost certain that several species are included. There are some differences, namely: the extent of the dorsal small dark patches/spots varies from a few to moderate numbers; the area between the abdominal sclerites and spiracles sometimes is a bit darker than rest; and there is some variation in the width of the nasale.

Identification

By rearing larvae collected in the field.

Remarks

Bertrand (1972) keyed out *Amphiops* larvae and briefly illustrated a presumed larva. Australian species appear to have less well-developed lateral abdominal protuberances than the specimen from the Indonesian Archipelago (Insulinde) illustrated by Bertrand (1972). Berge Henegouwen (1982) described an African species as having short conical outgrowths.

The noticeably lumpy sides to the abdomen, the very small prementum and labial palpi, and the lack of a ligula most readily identify specimens of *Amphiops*.

The form of the pupae is unusual, in particular the virtual absence of setae, the compact ventral surface and hard shield-like dorsal surface.

In the laboratory *A. queenslandicus* (and also *A. duplopunctatus*, of which a single larva was reared through to adult but the larval exuvium was lost) pupated above ground in the aquaria. This, together with the unusual shape and dark colour of the pupae, suggest that in the wild they pupate attached to the stems of emergent vegetation. Just how they physically attach themselves remains to be discovered.

Specimens examined

Queensland: 1 km W Mingela, 4/5/98.

Amphiops sp. **Northern Territory:** Jabiru,

21/3/98; 11 km E Jabiru, 19/3/98; Manton Dam, 23/3/98; Ormiston Gorge, 27/1/99. **Queensland:** 10 km S Cardwell, 7/2/97; 40 km S Cardwell, 7/2/97; 5 km NE Mt Molloy, 30/3/96; 2 km S Mt Molloy 30/3/96; Nardello's Lagoon near Mareeba, 29/3/96; same locality, 6/2/97; 10 km W Petrie, 23/11/95; 12 km NW Townsville, 8/2/97; 25 km S Townsville, 25/3/96.

Berosus Leach

Berosus australiae Mulsant. Fig. 5

Size of third instar. Length 6.5–1.05 mm (exclusive of gills); head capsule 0.75–0.95 mm long, 0.85–1.02 mm wide.

Head capsule. Subquadrate. Labroclypeus strongly asymmetrical; nasale narrow, strongly protruding, left of centre, with five to seven short teeth; lateral lobes of epistome asymmetrical, right one weakly projecting, left one strongly projected anteriorly, covering basal third of mandible, with several short, strong, curved spines. Frontal sulci lyriform, not coming together; absent on third instar larvae. Coronal sulcus absent. Gular sclerites absent, a pair of small, weakly sclerotised, cervical sclerites. With inverted U-shaped darker markings on dorsal surface.

Antennae. Three-segmented, relatively close together, arising just inwards of mandible bases. First segment a little longer than other two combined, with a stout subapical seta on inner margin. Sensory appendage on second segment, about half length of short third segment.

Mandibles. Slender, strongly asymmetrical; right mandible with large distal tooth and a very small central one; left mandible with group of seven small teeth or strong spines, some of which are bifid at tips.

Maxillae. Five-segmented. Stipes much longer than remaining segments combined, with four or five setae on inner margin. Palpus four-segmented; first segment short, subquadrate, with an inner process; second segment very short; third segment the longest; fourth a little longer than first.

Labium. Mentum short, poorly sclerotised. Prementum small, subquadrate. Palpus long, two-segmented, basal segment shorter than distal. Ligula absent or reduced to small bulge.

Thorax and legs. Prothorax with large dorsal sclerite, with sagittal line; ventral surface with a large subrectangular sclerite, hind edge strongly sinuate, with sagittal line. Mesothorax with two

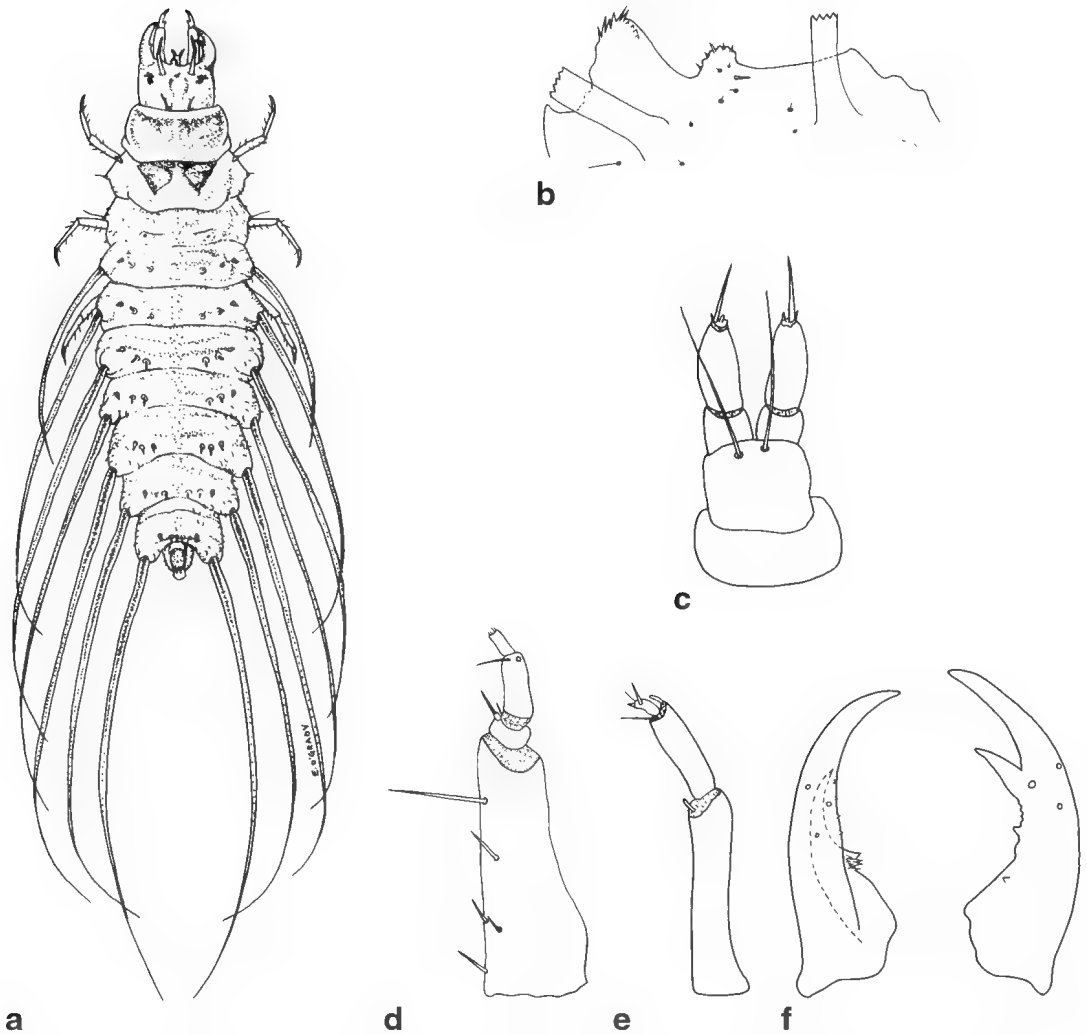


FIGURE 5. *Berosus australiae*. a, habitus; b, labroclypeus; c, labium; d, maxilla; e, antenna; f, mandibles.

dorsal pairs of sclerites, inner pair small, outer pair much larger, subtriangular. Metathorax lacking sclerites. Mesothorax and metathorax with a pair of small lateral tubercles bearing a long apical seta. Legs five-segmented, long, visible in dorsal view.

Abdomen. Abdominal segments 1 to 7 subdivided by a transverse fold; each with a pair of long, lateral, tracheal gills, and two pairs of small cylindrical structures on dorsal surface in a line inward from spiracles. Segment 8 small, with a dorsal sclerite; spiracular atrium absent. Urogomphi reduced. Integument densely covered

with small setae. Bases of gills with covering of small setae similar to those on adjacent abdominal segments. Each gill with a relatively long seta, arising from a small cylindrical base, towards tip. Dorsal surface often with darker patterning.

Spiracles. Nine pairs of non-functional spiracles, one mesothoracic and eight abdominal.

Intraspecific variation

There is some variation in the specimens I have identified as this species in the number and shape of the nasale teeth and in the presence/absence/strength of a dorsal colour pattern.

Interspecific variation

The description of *B. australiae* fits most of the specimens of *Berosus* that I have seen, many of which are unlikely to be *B. australiae*. I suspect that the description would fit the larvae of most species in the *B. australiae*, *B. majusculus* Blackburn, *B. veronicae* Watts group of Australian *Berosus*. There is some variation in colour and in the strength of setae on the integument (weak in *B. australiae*). Another group of specimens show clear differences from *B. australiae*: the nasale is central rather than to the left; the integument is covered with small dark-pigmented patches in various patterns; the abdominal segments have variably sized, but often marked, colour pattern; there are finger-like projections on the sides of the prothorax and a differently shaped eighth abdominal segment. These larvae are associated with species such as *B. queenslandicus* Blackburn and *B. involutus* (W. MacLeay).

Identification

By association and elimination.

Remarks

The long filamentous lateral gills and the absence of functional spiracles readily identify larvae of *Berosus*. The asymmetry of the mandibles and labroclypeus, stout maxillae and lack of a ligula are also distinctive, but are characters shared variously by a number of other genera. Within Australian species there is no sign of the variation in the number of pairs of lateral gills seen in African (Bertrand 1972) and New World (Archangelsky 1997) species.

Specimens examined

Queensland: Bohle River, 10 km N Townsville, 23/3/96.

Berosus sp. **New South Wales:** 8 km N Bombala, 28/11/98; ditto, 3/11/97; Collector, 20/1/97; 5 km NE Dartmoor, 11/10/96. **Northern Territory:** Mt Borradaile Station, 26/5/99; Nawurlandja, Kakadu National Park, 29/1/99. **Queensland:** Burdekin River, 2/11/95; 10 K S Cardwell, 7/2/97; Jourama Falls, 31/10/95; 5 km NE Mt Molloy, 30/3/96. **South Australia:** 10 km N Coonawarra; 19/10/99. **Victoria:** Simpson Creek, 12 km SW Orbost, 16/1/97. **Western Australia:** Gin Gin, 15/10/96; 4 km S New Norcia, 15/10/96.

Enochrus Thomson*Enochrus eyrensis* (Blackburn). Fig. 6

Size of third instar. Length 9.1 mm; head capsule 0.70–0.75 mm long; 0.75–0.80 mm wide.

Head capsule. Subquadrate. Labroclypeus asymmetrical; nasale obliquely truncate, left side shorter than right, with seven to nine short teeth, first two on right side and last one on left side largest; left lobe of epistome rounded, shorter than nasale; right lobe triangular, sharply pointed, about same length as nasale. Frontal sulci as an inverted bell, fusing just before reaching occipital foramen. Coronal sulcus very short. Gular sclerite absent. Cervical sclerites moderate, subrectangular.

Antennae. Three-segmented. In third instar first segment wider than second segment and about same length; second segment with small setae-bearing appendage on inside near middle; third segment about a third the length of the second. Sensory appendage on second segment much shorter than third segment.

Mandibles. Strongly asymmetrical; right mandible with two strong inner teeth on basal half; left mandible with one strong inner tooth. Inner margin of right distal tooth and distal parts of both mandibles serrated.

Maxillae. Five-segmented. Stipes wide, much longer than remaining segments combined, with four strong setae on inner margin. Palpus four-segmented; first segment subrectangular, a little wider than long, with an inner process a little shorter than second palpal segment; second segment short; third and fourth segments about twice as long as second, subequal in length.

Labium. Mentum subtrapezoidal, dorsal surface with two short stout spines in middle towards front, three strong spines laterally, anteriolateral angles each with a strong spine. Prementum squat, a little wider at base, shorter than mentum. Palpus two-segmented, first segment short, second segment approximately twice as long as first. Ligula slender, longer than first palpal segment, with partial ring of small spines around bases of palpal segments.

Thorax and legs. Prothorax completely covered by a dorsal sclerite, with sagittal line; two small very narrow sclerites on rear edge; front half of ventral surface with large sclerite with sagittal line. Mesothorax with large rectangular dorsal sclerite with sagittal line, with numerous strong setae; anterior half of metathorax with dorsal sclerite with sagittal line, posterior half with two

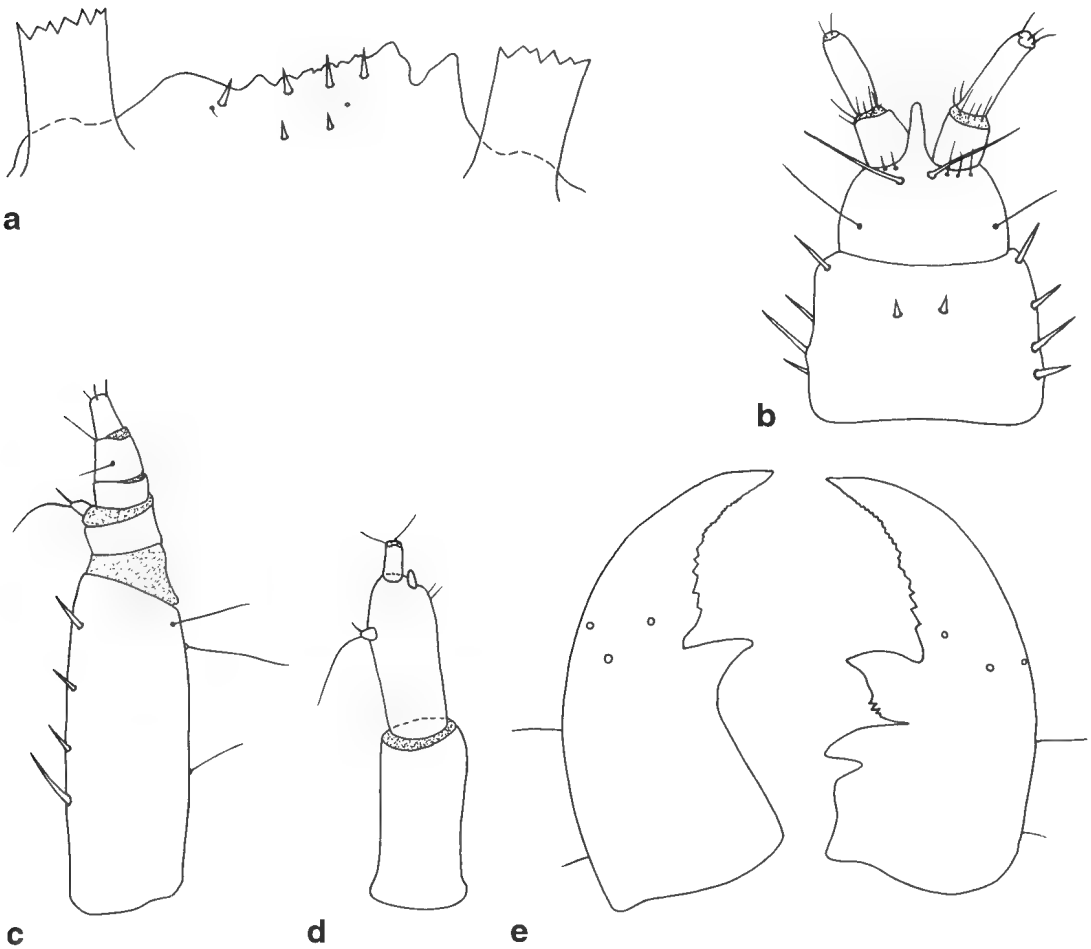


FIGURE 6. *Enochrus eyrensis*. a, labroclypeus; b, labium; c, maxilla; d, antenna e, mandibles.

small foot-shaped sclerites. Legs five-segmented, well developed, visible in dorsal view.

Abdomen. Segments 1 to 7 similar in shape and size, subdivided into three or four transverse folds; segment 1 with two dorsal pairs of small suboval sclerites, the anterior pair much the smaller. Segment 8 with a large, suboval, dorsal sclerite. Segment 9 trilobed, with a pair of short one-segmented urogomphi. Segments 2 to 7 with ventral pair of small protuberances covered with relatively strong, hooked setae (prolegs). Integument rather sparsely covered with small setae.

Spiracles. Nine pairs; one mesothoracic and eight abdominal. Mesothoracic and first seven abdominal spiracles non-functional. Spiracles on

segment 8 annular, large and functional, within the spiracular atrium.

Intraspecific variation

No significant variation within the few specimens seen.

Interspecific variation

Within the few specimens available, which must include at least two additional species, there is some variation in the distribution of setae on the thoracic sclerites, in the number and relative size of the nasale teeth, and in the length of the ligula.

Specimens of *E. mastersi* differ more substantially in: pattern of setae on integument,

the presence of abdominal sclerites, lack of prolegs, the number of mandibular teeth, and the smaller and more distal lateral protuberance on the second antennal segment. The species is separately described below.

Identification

By rearing larvae collected in the field.

Remarks

The larvae of the Australian *E. (Methyrus) maculiceps* (MacLeay) (Anderson 1976) and *E. (M.) eyrensis* differ little from those of the North American *E. (Lumetus) ochraceus* (Melsheimer) (Archangelsky 1997) and *E. (L.) fimbriatus* (Richmond 1920, as *E. perplexus* (le Conte)) except possibly in a squatter mentum. *Enochrus (Hydatotrepis) mastersi* differs from all of the above by the nearly symmetrical mandibles and the lack of obvious setiferous prolegs, and from *E. (M.) eyrensis*, by the more elongate and spinose mentum. In these characters, other than the absence of prolegs, it more closely resembles larvae of the subgenus *Lumetus* than those of *Methyrus*.

All known larvae of *Enochrus* share with most *Helochares* the angled nasale. Apart from *E. mastersi*, they are readily separated from *Helochares* by the asymmetrical mandibles. *Enochrus mastersi* can be separated from *Helochares* by having the ligula shorter rather than longer than the basal segment of the labial palpus, in the lack of a basal patch of strong setae on the maxillary stipe, and in the presence of small dorsal sclerites on the abdominal segments.

Specimens examined

South Australia: 2 km S Penola, 10/99.

Enochrus sp. **Queensland:** Bohle River, 10 km N Townsville, 23/3/96; 30 km SE Townsville 4/5/98. **South Australia:** Mandina Lakes, 15/10/00; Tea Tree Gully, 7/5/97.

Enochrus mastersi (W. MacLeay). Fig. 7

Size of third instar. Length 12.0 mm; head capsule 1.30 mm long, 1.13 mm wide.

Head capsule. Subquadrate. Labroclypeus weakly asymmetrical; nasale obliquely truncate, left side shorter than right, with seven to eight short teeth, first two on right side and last one on left side largest; left lobe of epistome more rounded than right, shorter than nasale. Frontal sulci as an inverted bell, fusing before reaching occipital foramen. Coronal sulcus very short.

Gular sclerite absent. Cervical sclerites small, subrectangular.

Antennae. Three-segmented. First segment wider than second segment, shorter than second in first instar larvae, about 1.5 times as long as second in third instar larvae, slightly bulging on inner apical corner; third segment about a third the length of the second. Sensory appendage on second segment much shorter than third segment.

Mandibles. Weakly asymmetrical; right mandible with two strong inner teeth on basal half; left mandible with one strong inner tooth and one much weaker tooth. Inner margins of distal teeth and distal parts of mandibles serrated.

Maxillae. Five-segmented. Stipes wide, much longer than remaining segments combined, with four strong setae on inner margin. Palpus four-segmented; first segment subrectangular, as wide as long, with an inner process a little shorter than second palpal segment; second segment short; third and four segments slightly longer, subequal in length.

Labium. Mentum rectangular, dorsal surface with scattered cuticular spines and several strong spines at front and side edges. Prementum rounded, a little wider at base, shorter than mentum. Palpus two-segmented, first segment short, second segment 1.0–1.5 times longer than first, some small spines at the bases of both segments. Ligula slender, as long as first palpal segment.

Thorax and legs. Prothorax completely covered by a dorsal sclerite, with sagittal line, with numerous relatively long setae; ventral surface with two subrectangular sclerites. Mesothorax with a pair of large dorsal sclerites with irregular posterior margins, covered with relatively long setae. Metathorax with narrow pair of dorsal sclerites each with a small foot-shaped backward extension, covered with relatively long setae. Legs five-segmented, well developed, visible in dorsal view.

Abdomen. Segments 1 to 7 similar in shape and size, subdivided into three or four transverse folds; segments 1 to 6 with a dorsal pair of small suboval sclerites. Segment 8 with a large, suboval, dorsal sclerite. Segment 9 trilobed, with a pair of short one-segmented urogomphi. Integument covered with dense, small setae, in many places organised into tight bundles.

Spiracles. Nine pairs; one mesothoracic and eight abdominal. Mesothoracic and first seven abdominal spiracles non-functional. Spiracles on segment 8 annular, large and functional, within the spiracular atrium.

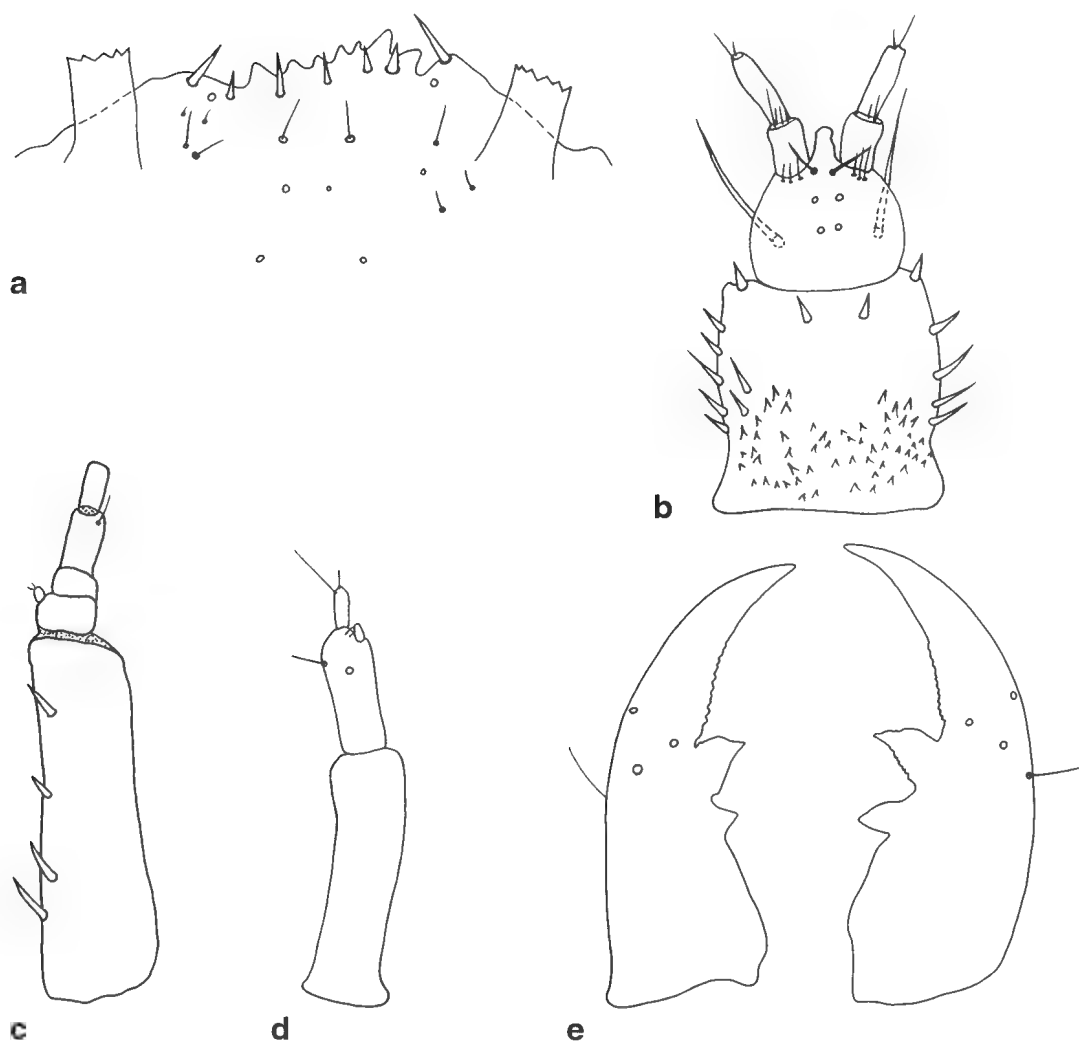


FIGURE 7. *Enochrus mastersi*. a, labroclypeus; b, labium; c, maxilla; d, antenna; e, mandibles.

Intraspecific variation

Only three specimens are known. They vary slightly in size of the abdominal sclerites but otherwise are very similar.

Interspecific variation

See under *E. eyrensis*.

Identification

By association and elimination.

Specimens examined

New South Wales: Salisbury, 26/11/95.

Northern Territory: Ormiston Gorge, 27/1/99.

Victoria: King Parrot Creek, 2/12/98.

Helochaeres Mulsant

Helochaeres tristis W. MacLeay. Fig. 8

Size of third instar. Length 6.8–10.0 mm; head capsule, 0.53–0.56 mm long, 0.66–0.69 mm wide.

Head capsule. Subquadrate. Labroclypeus asymmetrical; nasale obliquely truncate, shorter on left side, with six small teeth; lateral lobes of epistome project nearly as far as nasale. Frontal sulci inversely bell-shaped, meeting before reaching occipital foramen. Coronal sulcus very short. Gular sclerite absent. Cervical sclerites narrow, subrectangular.

Antennae. Three-segmented. First segment as

long as second (first instar larvae) or longer (second and third instar larvae); second segment with a slim apical sensory appendage on inside which is half the length of third segment; third segment much smaller than second.

Mandibles. Slightly asymmetrical; two inner teeth in middle, distal one larger on left mandible, only slightly larger on right mandible. Distal inner margin and inner margins of teeth slightly serrated. Distal part of teeth darker.

Maxillae. Five-segmented. Stipes wide, longer than remaining segments combined, with a row of four stout setae on inner margin, base with a tuft of strong spines. Palpus four-segmented; first segment subrectangular, with an inner process a little longer than the second palpal segment; second segment the shortest; third segment longest; last segment slightly shorter than third.

Labium. Mentum large, subquadrate, with dorsal surface covered by strong cuticular spines. Prementum subrectangular, wider than long. Palpus two-segmented, basal segment very short, distal segment three to four times longer than basal; a few small spines at base of apical segment. Ligula about twice as long as first palpal segment.

Thorax and legs. Prothorax almost completely covered by a dorsal sclerite, with sagittal line; ventral surface with a subrectangular plate, with a sagittal line. Mesothorax with a pair of large rectangular dorsal sclerites; metathorax with a pair of small dorsal sclerites, irregular in shape, composed of a wide and narrow basal portion and an L-shaped central portion arising from the middle of the basal piece. Legs five-segmented, well developed, visible in dorsal view.

Abdomen. Segment 1 with two dorsal pairs of small, narrow, irregularly shaped sclerites; anterior pair much smaller. Segments 1 to 7 similar in size and shape, subdivided by three or four transverse folds; pleura of segments 1 to 7 with three longitudinal slight bulges, the most ventral one in three lobes, each segment with a dorsal pair of setae towards the middle arising from a small circular sclerite or dark-pigmented area, and a small seta a little inwards and backwards from each spiracle. Segment 8 with a large, suboval, dorsal sclerite, serrate on posterior edge and pair of short apical flaps. Segment 9 trilobed; with a pair of small one-segmented urogomphi; central lobe largest. Integument densely covered in short fine setae.

Spiracles. Nine pairs; one mesothoracic and eight abdominal, raised slightly above the surface. Mesothoracic and first seven abdominal spiracles

non-functional. Spiracles on segment 8 annular, large and functional, within the spiracular atrium.

Intraspecific variation

There is some variation in the shape of the thoracic sclerites and in the shape and configuration of the nasale teeth.

Interspecific variation

H. luridus (W. MacLeay) and *H. clypeatus* Watts. As for *H. tristis*.

H. tenuistriatus Regimbart. The integument is predominantly covered by long thin setae rather than the short and very curved setae found in *H. tristis*, *H. luridus* and *H. clypeatus*. This gives a distinct furry look to the larvae.

H. foveicollis (Montrouzier). Differs in lacking nasale, having a slight bulge on the inside of antenna and a number of other characters (see below). These differences are sufficient to warrant a separate description (see below).

Other *Helochares* species. Within specimens unidentified to species there is variation in: form of the small setae on the integument; the shape of the metasternal sclerites; and the presence/absence, position and shape of the abdominal sclerites.

Identification

H. tristis, *H. luridus* and *H. clypeatus* by rearing larvae collected in the field; *H. tenuistriatus* by association and elimination.

Remarks

Within the known Australian *Helochares* larvae there are clearly two groups: *H. foveicollis*; and *H. tristis*, *H. luridus*, *H. tenuistriatus* and *H. clypeatus*. These correspond to the subgenera *Helochares* and *Hydrobaticus* Blackburn, respectively, and strongly reinforce the distinctiveness of these groups as reflected in the classification. Within Australian *H. (Hydrobaticus)* there is very little difference between the known species or among the large number of unidentified larvae. In addition, there is minimal difference between these Australian *H. (Hydrobaticus)* and the North American *H. (Hydrobaticus) maculicollis* Mulsant (Archangelsky 1997; Richmond 1920) or the South American *H. (Sindolus) talarum* Fernandez and *H. (Helochares) pallipes* (Brulle) (Fernandez 1983) or the European *H. (Helochares) obscurus* (Muller) (as *griseus* Heer) (Boving & Henriksen 1938).

The larvae of *H. (Helochares) foveicollis* differ

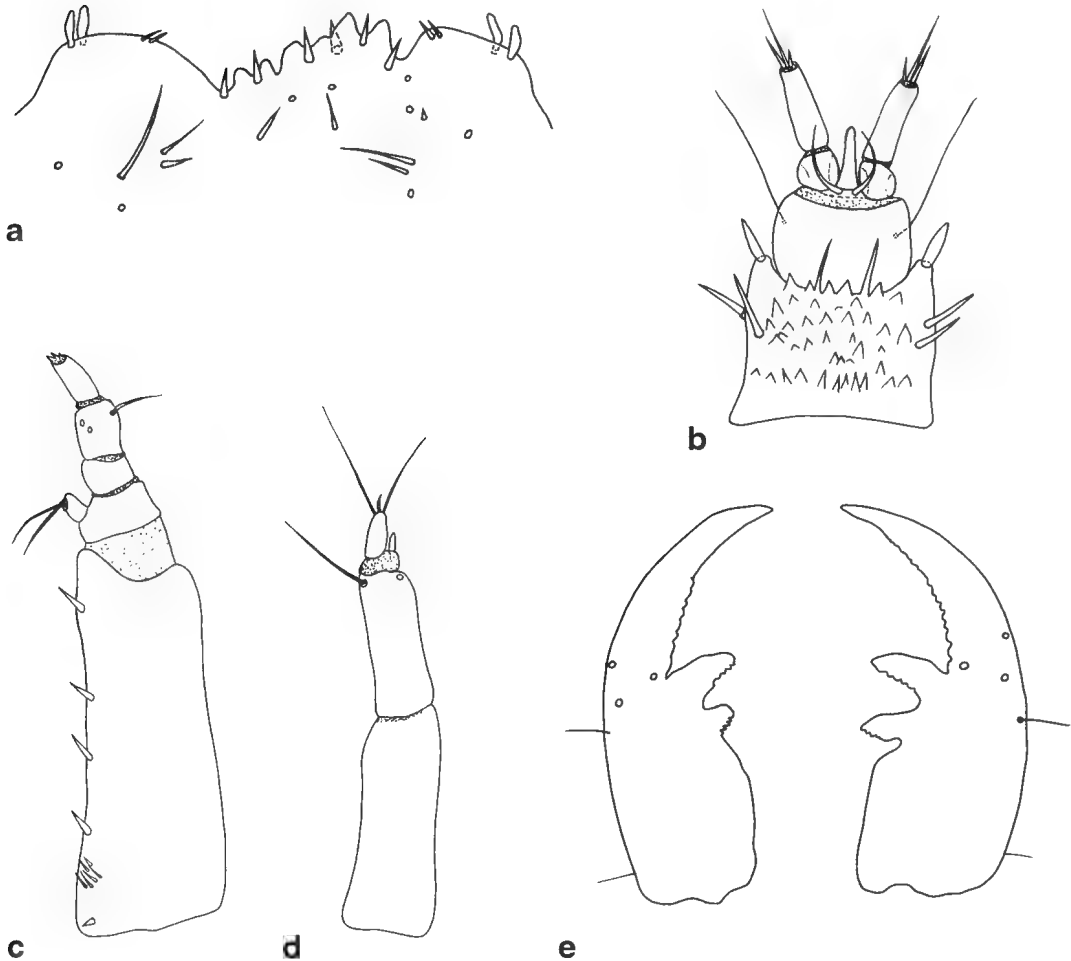


FIGURE 8. *Helochares tristis*. a, labroclypeus; b, labium; c, maxilla; d, antenna e, mandibles.

considerably from all of these species in a number of characters, most noticeably the symmetrical labroclypeus and the more elongate antennae and maxillary palpi (see later).

The larva of the related Australian genus, *Chasmogenus*, is only known from the work of Anderson (1976). It also has a symmetric labroclypeus but differs from both *H. (Helochares) foveicollis* and *H. (Hydrobaticus) tristis* in the asymmetric mandibles, one with one tooth and the other with two, and in the complete rather than partial dorsal sclerites on the metathorax.

Species of *H. (Hydrobaticus)* appear to breed more or less continuously and females are frequently caught with egg masses attached to

their abdomens, although Anderson (1976) found that there was a distinct spring breeding season in *H. tristis* near Sydney. Larvae are among the most commonly collected Hydrophilid larvae, often found together with those of *Limnoxenus* in the south and both *Limnoxenus* and *Sternolophus* in the north. They can be readily separated from both of these by their angled nasale and mandibles with two rather than three teeth.

Although adults of *Enochrus* are often more common than those of *Helochares*, their larvae are, for unknown reasons, rarely found. They share with *H. (Hydatotrepis)* the angled nasale but, other than *E. mastersi*, have strongly asymmetrical mandibles. Larvae of *E. mastersi* resemble those of *H. (Hydatotrepis)* quite closely

but differ in lacking a cluster of strong setae at the base of the maxillary palpus, and in having the ligula shorter than the basal segment of the labial palpus.

Specimens examined

New South Wales: 20 km W Nelligan, 3/11/97. **South Australia:** 10 km N Coonawarra, 26/9/98; Cudlee Creek, 10/11/96; Kuitpo, 5/10/95; 13 km W Meadows, 26/9/96; Mt Crawford State Forest, 10/11/96; Tea Tree Gully, 7/5/97. **Victoria:** 10 km W Cowwarr, 30/11/98; Healsville, 12/68.

H. tenuistriatus. **Western Australia:** 30 km N Perth, 14/10/96

H. clypeatus. **Northern Territory:** Nourlangie Creek, 20 km SSW Jabiru, 11/10/98.

H. luridus. **Queensland:** Burdekin River E of Charters Towers, 4/5/98.

Helocharus sp. **New South Wales:** 12 km E Tamworth, 26/11/95. **Northern Territory:** Nawurlandja, Kakadu National Park, 22/3/98. **Queensland:** Alligator River 20 km S Townsville, 25/3/96; Bluewater, 22/3/96; Bowling Green Bay National Park, 6/11/95; 10 km N Cairns, 4/1/97; Eubenangee Swamp, 4/2/97; 8 km S Greenvale, 27/3/96; Jourama Falls near Townsville, 31/10/95; 1 km W Mingela, 4/5/98; Star River, 1/11/95; 30 km SE Townsville, 4/5/98.

Helochares foveicollis (Montrouzier). Fig. 9

Size of third instar. Length 13.5 mm; head capsule 0.78 mm long, 0.94 mm wide.

Head capsule. Subquadrate. Labroclypeus symmetrical, without nasale; with eight to nine small teeth along front edge in middle; lateral lobes of epistome slight. Frontal sulci inversely bell-shaped, meeting before reaching occipital foramen. Coronal sulcus short. Gular sclerite absent. Cervical sclerites small, subrectangular.

Antennae. Three-segmented. First segment as long as second (first instar larvae) or longer (second and third instar larvae), with distinct protruberance on inside near apex; second segment with a slim apical sensory appendage on inside, half the length of third segment; third segment much thinner than second.

Mandibles. Relatively slim, symmetrical; two inner teeth in middle, distal one much larger. Outer margin of apical tooth weakly serrated.

Maxillae. Five-segmented. Stipes relatively narrow, much longer than remaining segments combined, with a row of five stout setae on inner

margin, base with a few short, strong spines. Palpus four-segmented; first segment subrectangular with an inner process as long as the second palpal segment; second segment the shortest; third segment the longest; fourth segment shorter than third.

Labium. Mentum large, subquadrate, with central portion of dorsal surface covered by weak cuticular spines and a semicircle of six spines, anterolateral angles sharp, each with a small spine. Prementum elongate-rectangular, longer than wide. Palpus two-segmented, basal very short, distal segment four to five times longer than basal one. Ligula short, thick, about twice the length of first palpal segment.

Thorax and legs. Prothorax almost completely covered by a dorsal sclerite, with sagittal line; ventral surface with a subrectangular sclerite, subdivided by a sagittal line. Mesothorax with a pair of large dorsal sclerites; metathorax with a pair of small dorsal sclerites composed of a wide and narrow basal portion and an L-shaped portion arising from the middle of the basal piece, 'heel' reaching posterior margin. Legs five-segmented, well developed, visible in dorsal view.

Abdomen. Segments 1 to 7 similar in size and shape, subdivided by three or four transverse folds; segment 1 with two dorsal pairs of small narrow basal sclerites, the anterior pair smallest; pleura of segments 1 to 7 each with three to four weak longitudinal bulges, a well separated pair of strong dorsal setae arising from a very small circular darkly pigmented area, a moderately strong seta just inwards and behind each spiracle. Segment 8 with a large, suboval, dorsal sclerite with a ragged hind edge, and a pair of prominent apical flaps; segment 9 trilobed, central lobe largest and sclerotised, with a pair of prominent one-segmented urogomphi. Integument covered with moderately dense hair-like setae.

Spiracles. Nine pairs; one mesothoracic and eight abdominal. Mesothoracic and first seven abdominal spiracles very small, non-functional. Spiracles on segment 8 annular, large and functional, within the spiracular atrium.

Intraspecific variation

Among the few specimens known there is some variation in the number of larger spines on the mentum and in wear on the nasale teeth.

Interspecific variation

Helochares foveicollis differs from other known Australian *Helochares* larvae by the lack of a nasale, presence of a prominent bulge on the

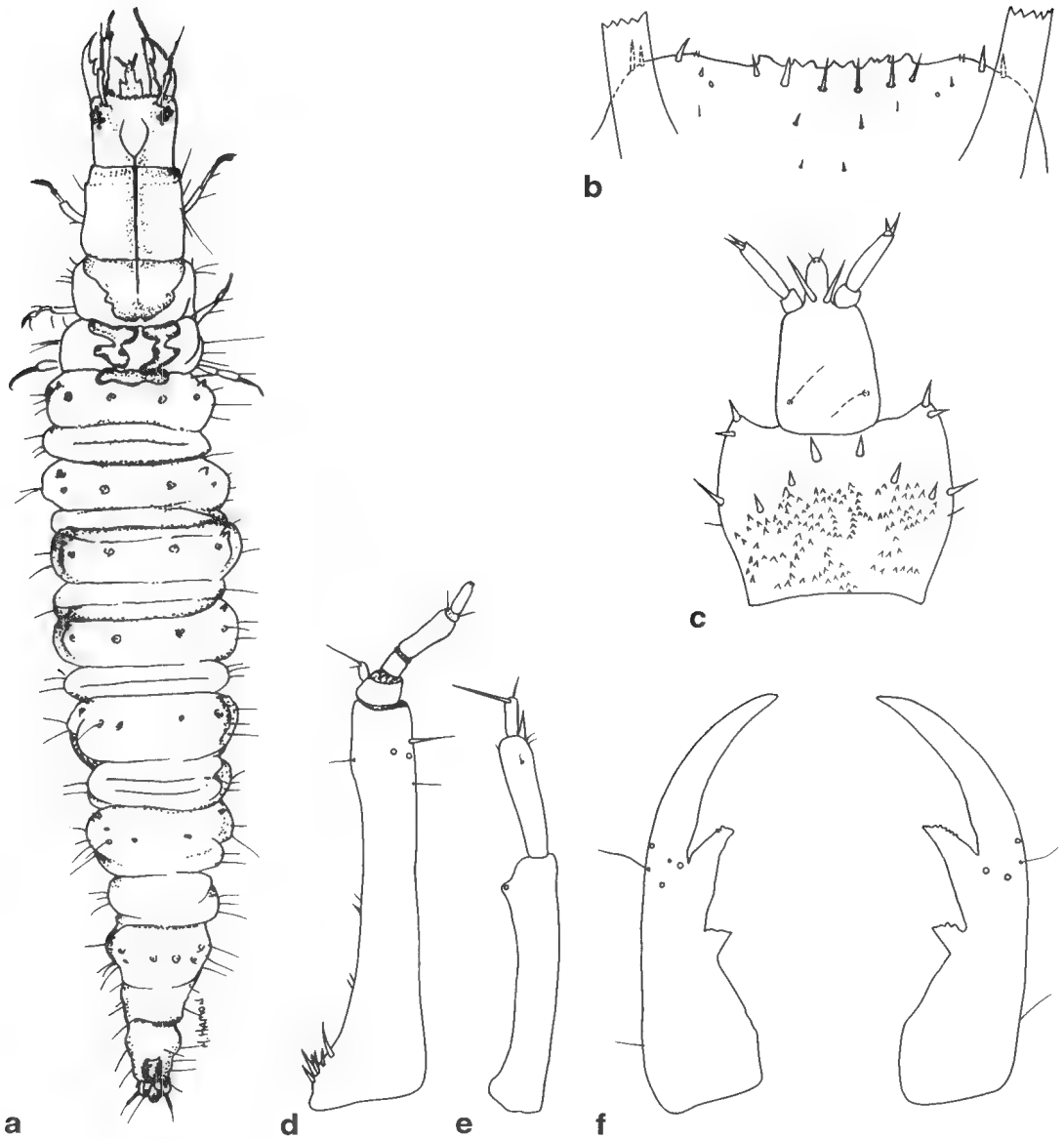


FIGURE 9. *Helochaeres foveicollis*. a, habitus; b, labroclypeus; c, labium; d, maxilla; e, antenna; f, mandibles.

inside of the antennae, proportionally longer and narrower prementum and ligula, more elongate maxillary palpi and the shape of the metathoracic sclerites (Fig. 9).

Identification

By rearing field-caught larvae and rearing from egg mass attached to female.

Remarks

On adult characters *H. foveicollis* is presently placed in the subgenus *Helochaeres* together with *H. obscurus* and *H. pallipes*. However larval characters do not support this placement, nor its placement in either of the subgenera *Hydatotrephis* or *Sindolus*.

Specimens examined

Northern Territory: Manton Dam, 2/2/99; 2 km S Adelaide River, 1/2/99. **Queensland:** 40 km S Townsville, 2/2/97.

Hybogramalus Orchymont

Hybogramalus hartmeyeri (Regimbart). Figs 10, 17b

Size of third instar. Length 10.0 mm; head capsule 1.60–1.79 mm long, 1.62–2.00 mm wide

Head capsule. Rectangular. Labroclypeus asymmetrical; nasale narrow, projecting well forward, with five teeth, the two lateral ones more distant than rest; lateral lobes of epistome rounded, projecting farther than nasale, left lobe often larger, with a strong comb of stout spines on front edge, front edge of right lobe with a few scattered spines. Frontal sulci U to V-shaped, fusing just before reaching occipital foramen. Coronal sulcus short. Gular sclerite absent. Cervical sclerites relatively small, subrectangular.

Antennae. Three-segmented. First segment longer than remaining segments combined; second segment about 1.5 times the length of third segment which is very thin. Sensory appendage on second segment minute.

Mandibles. Asymmetrical; right mandible with three inner teeth, the anterior one largest; left mandible with three teeth of approximately the same size, central one with patch of strong setae at base.

Maxillae. Five-segmented. Stipes stout, longer than remaining segments combined, with four long stout setae on inner margin. Palpus four-segmented; first segment widest, with a short inner process; second segment short; third segment longest; fourth segment about half length of third.

Labium. Mentum small, subrectangular, sides slightly convex, dorsal surface with small spines, anterolateral angles rounded with several stout spines. Prementum elongate, rectangular, as long as mentum. Palpus two-segmented, first segment the shortest. Ligula present, about as long as the first palpal segment, tip weakly bifid.

Thorax and legs. Prothorax with large dorsal sclerite, with sagittal line; ventral surface with a large subrectangular sclerite, with sagittal line. Mesothorax with a pair of large triangular dorsal sclerites. Metathorax with a pair of semicircular dorsal sclerites and a more posterior pair of much smaller circular ones. Sclerites, particularly the

anterior ones, covered with very short spines, occasionally arranged in short rows; rest of thorax densely covered with short fine setae with a few much longer setae laterally. Legs five-segmented, relatively short, just visible in dorsal view.

Abdomen. Segments 1 to 8 similar in shape, tapering towards the caudal end; Segments 1 to 7 subdivided into three or four transverse folds; sides of each segment with some slight, fleshy bulges, with one to two long setae. Segment 8 with two transverse folds, without dorsal sclerite. Segment 9 with hind margin weakly concave. Below segment 9, and projecting just beyond, are two prominent broad lobes. Integument densely covered with small fine setae.

Spiracles. Nine pairs; one mesothoracic and eight abdominal. Mesothoracic and first seven abdominal spiracles on small papillae. Spiracles on segment 8 (if present at all) obsolete and certainly non-functional.

Pupa (Fig. 17b). Head without styli. Pronotum with 22 styli, 16 around margins and 6 on disc. Mesonotum and metanotum each with one pair of styli near the midline. Abdominal segments 1 to 7 with a row of four styli on the terga, segments 2 to 7 with one stylus on each pleuron; segment 8 without styli; segment 9 with a pair of long urogomphi.

Intraspecific variation

One specimen has a slight mandibular tooth anterior to the normal ones (Fig. 1); otherwise, there is little variation other than in tooth wear between the few known specimens.

Identification

By rearing from larvae collected in the field.

Specimens examined

Western Australia: Gooseberry Hill, 14/9/00.

Remarks

Hybogramalus is a monospecific Australian genus known only from a couple of localities in the escarpment region of the Darling Ranges east of Perth, Western Australia where it lives in small temporary winter/spring streams. Although placed with *Limnoxenus* in the subtribe Hydrobiina of the tribe Hydrophilini (Hansen 1991), the larvae of the two genera have little in common. Several features of the larvae of *Hybogramalus* stand out: the lack of a spiracular atrium, the strongly asymmetric labroclypeus, the narrow prominent nasale, the strongly asymmetrical mandibles, and the rings of small spines at the base of the

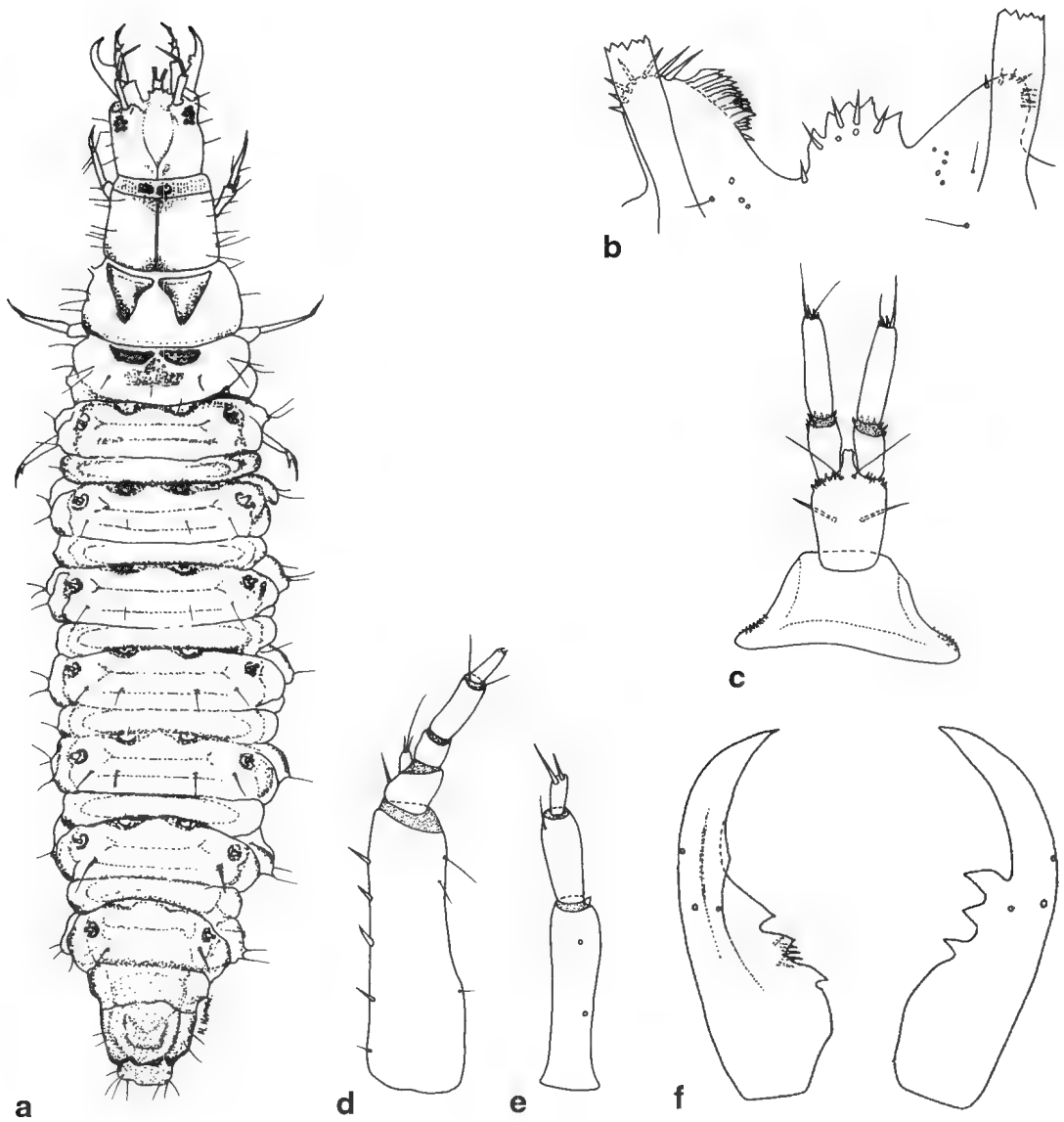


FIGURE 10. *Hybograllius hartmeyeri* a, habitus; b, labroclypeus; c, labium; d, maxilla; e, antenna; f, mandibles.

segments of the labial palpi. In most of these characters it most closely resembles *Berosus*. Apart from the lack of a spiracular atrium and the presence of a coronal sulcus, it also resembles the larvae of *Oocyclus* Sharp and *Laccobius* in the tribe Laccobiini. To what degree these similarities reflect phylogenetic relationships remains to be seen.

As well as the lack of a functional apical spiracle, the main tracheal trunks are narrower than most other genera and the spiracles are not

much larger, if at all, than those of other genera where they are considered non-functional. How the larvae manage to breathe is a puzzle.

Hydrobiomorpha Blackburn

Hydrobiomorpha sp. Fig. 11

Size of third instar. Length 15.0 mm; head capsule 1.65 mm long, 1.70 mm wide.

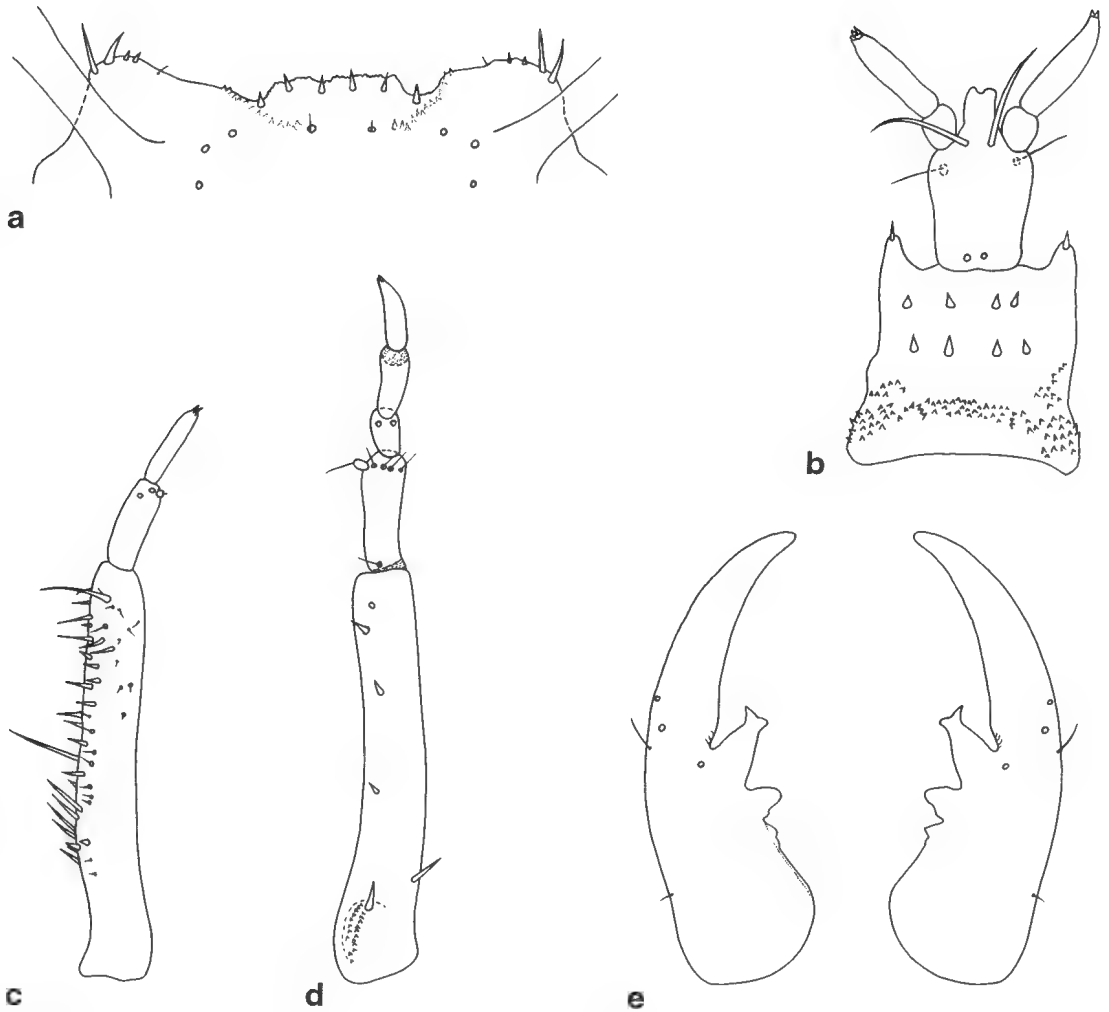


FIGURE 11. *Hydrobiomorpha* sp. **a**, labroclypeus; **b**, labium; **c**, maxilla; **d**, antenna; **e**, mandibles.

Head capsule. Subquadrate. Labroclypeus slightly asymmetrical; nasale truncate, edge rough rather than toothed; lateral lobes of epistome rounded, projecting further than nasale. Frontal sulci V-shaped, meeting before reaching occipital foramen. Coronal sulcus short. Gular sclerite absent. Cervical sclerites small, subquadrate. Numerous small darker patches on posterolateral angles and within frontal sulci.

Antennae. Three-segmented. First segment slender, three times longer than remaining segments combined (third instar larvae), inner margins with numerous short spines; second segment as long as third. Sensory appendage of second segment very small.

Mandibles. Symmetrical, sharply pointed; right mandible with three teeth on basal half, distal one large, bifid apically, central tooth smaller, basal one much smaller; left mandible similar to right except for basal tooth placed slightly more ventrally.

Maxillae. Five-segmented. Stipes slender, longer than remaining segments combined, with a group of short spines on inner margin at base, and several setae along inner and outer margins. Palpus four-segmented; first segment longest, with a short inner process; second segment the shortest; third and fourth segments subequal in length, each twice as long as second segment.

Labium. Mentum approximately square,

anterolateral angles projected, each with a pair of very small spines; dorsal surface with eight short, stout setae on distal two-thirds, and short cuticular spines on basal third. Prementum longer than wide, half the width of mentum. Palpus two-segmented, distal segment three to four times longer than basal segment. Ligula a little longer than first palpal segment, weakly bifid.

Thorax and legs. Prothorax covered by a large dorsal sclerite, posterior end rounded, sagittal line present; ventral sclerite large, subrectangular, with sagittal line. Mesothorax with pair of irregularly shaped sclerites, wider anteriorly, with sagittal line. Metathorax with pair of small irregularly shaped sclerites. Legs five-segmented, long, visible in dorsal view. Prothorax and mesothorax covered with small, scattered, dark patches.

Abdomen. First segment subdivided into two transverse folds, with a dorsal pair of narrow sclerites near anterior edge; segments 2 to 7 subdivided into four or five transverse folds, without sclerites. Segments 1 to 7 each with eight setose tubercles, four dorsal and two on each lateral margin; pleura weakly lobed. Segment 8 with a small, suboval, dorsal sclerite, posterior apex subdivided into four lobes and a pair of small procerci. Segment 9 round, with three small dorsal sclerites, bearing a pair of short, one-segmented urogomphi, and a pair of long paracerci; a pair of gill-like appendages (prostyli) originate on ventral side. Integument sparsely covered with relatively long setae. Single, narrow, darker line along midline of dorsal surface.

Spiracles. Nine pairs; one mesothoracic and eight abdominal. Mesothoracic and first seven abdominal spiracles non-functional. Spiracles on segment 8 annular, large and functional, within the spiracular atrium.

Identification

Agreement with generic description by Archangelsky (1997). Specimens were taken in association with *H. bovilli* Blackburn and are almost certainly that species.

Interspecific variation

There is little variation between the two known specimens.

Remarks

The larvae described above differ little from those of the New World *H. casta* (Archangelsky 1997; Spangler 1973) or the unidentified African species described by Berge Henegouwen (1982).

The peculiar shape of the anterior mandibular tooth is diagnostic within the Australian fauna.

Specimens examined

Northern Territory: Holmes Jungle, 28/11/99.

Hydrophilus Geoffroy

Hydrophilus bilineatus (MacLeay). Fig. 12

Size of third instar. Length 35 mm; head capsule 3.25 mm long, 4.25 mm wide.

Head capsule. Suboval. Labroclypeus virtually symmetrical; nasale undeveloped; lateral lobes of epistome rounded, projecting farther than nasale. Frontal sulci broadly U-shaped, fusing just before reaching occipital foramen. Coronal sulcus present, very short. Gular sclerite absent. Cervical sclerites small, suboval.

Antennae. Four-segmented. First segment slender, slightly constricted near base, longer than remaining segments combined, with some slender setae on distal two-thirds of inner margin; second segment short, constricted near base in first instar larvae, third and fourth segments subequal in length. Sensory appendage on third segment reduced to a small papilla.

Mandibles. Asymmetrical; right mandible longer, more slender, with a large tooth on basal half which is divided by a longitudinal groove into ventral and dorsal sections; left mandible shorter, with one small inner tooth on basal half.

Maxillae. Five-segmented. Stipes narrow, elongate, longer than remaining segments combined, with three stout setae on inner margin. Palpus four-segmented; first segment the longest, with a short inner process; second and third segments subequal in length; fourth segment slightly shorter.

Labium. Mentum subrectangular, sides convex, anterolateral angles lobed, central third with some small spines (without spines in first and second instars). Prementum subtrapezoidal, anterior end wider with a pair of small protuberances towards front. Palpus two-segmented, first segment shortest. Ligula present, much shorter than first palpal segment.

Thorax and legs. Prothorax with two large sclerites together covering most of dorsal surface, the triangular area anterior to these sclerites usually sclerotised; ventral surface with a large subrectangular sclerite, with sagittal line. Mesothorax with a pair of subtriangular dorsal sclerites. Metathorax with a pair of narrow, basal

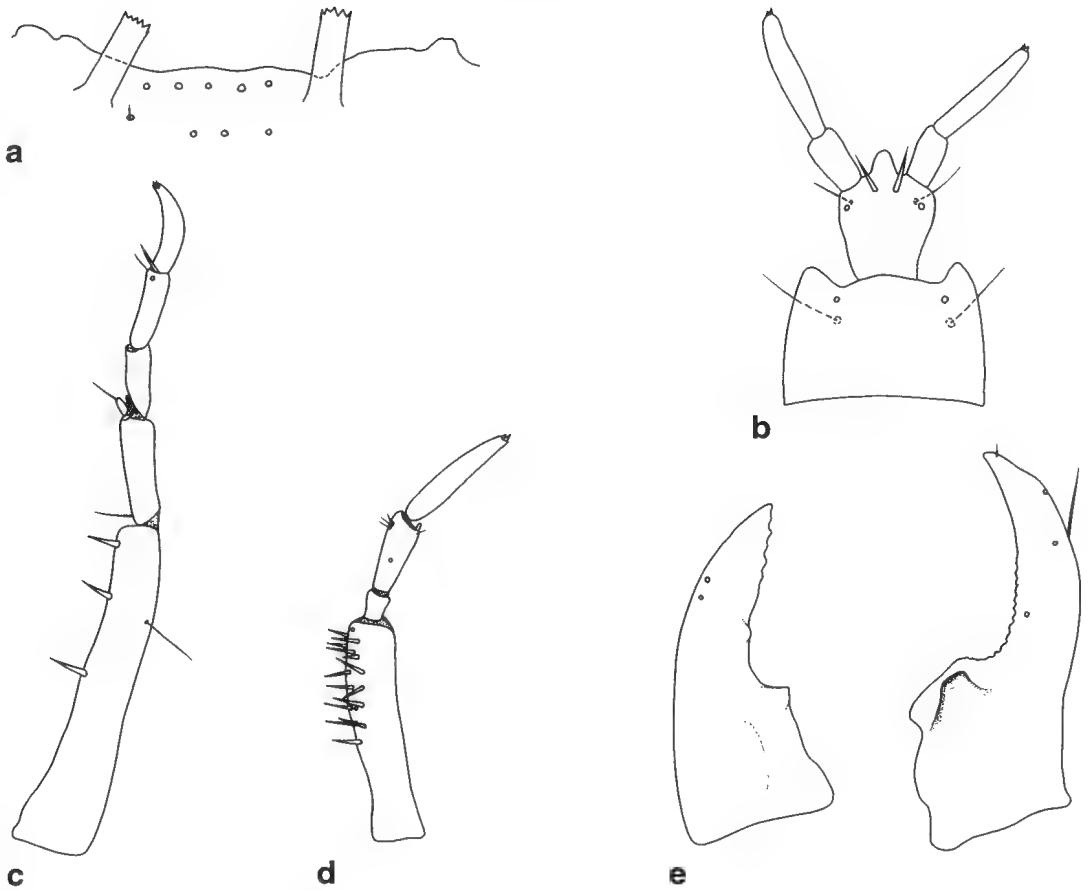


FIGURE 12. *Hydrophilus bilineatus*. a, labroclypeus; b, labium; c, maxilla; d, antenna; e, mandibles.

sclerites and a more central pair of small irregularly-shaped ones. Legs five-segmented, relatively short, visible in dorsal view, with rows of long swimming setae on both dorsal and ventral edges of femur and tibiotarsus.

Abdomen. Segments 1 to 6 similar in shape, tapering towards the caudal end; segments 7 to 8 more elongate and slender. Segments 1 to 7 subdivided into three transverse folds; third fold with two lateral and two dorsal small tubercles, more obvious on posterior segments. Pleura 1 to 8 each with a small lateral tubercle. Segment 8 with two small subtriangular sclerites at posterior end; segment 9 slightly trilobed, with a pair of short one-segmented urogomphi, ventromedially with a pair of long gill-like appendages. Integument in first instar very densely covered with small thin setae; in second and third instars moderately

covered with thin, relatively long setae and numerous small 'bumps'.

Spiracles. Nine pairs; one mesothoracic and eight abdominal. Mesothoracic and first seven abdominal spiracles very small, non-functional. Spiracles on segment 8 annular, large and functional, within the spiracular atrium.

Identification

By association and elimination.

Intraspecific variation

I have not noticed any significant variation within the few available specimens I have identified as *H. bilineatus*.

Interspecific variation

Within the larvae available there is considerable

variation in a number of characters, most notably: number of antennal segments vary from three to four; the presence/absence/form of the lateral projections on the abdominal segments; form of covering of the integument; dorsal colour pattern.

Remarks

The larvae of two European species, *H. piceus* Linnaeus and *H. aterrimus* Eschscholtz, and the North American *H. triangularis* (Say) are well known (Archangelsky 1997; Boving & Henriksen 1938; Richmond 1920). In addition, the larvae of *H. senegalensis* (Percheron) (Berge Henegouwen 1982; Africa) and *H. acuminatus* Motschulsky (Morioka 1955; Japan) have been described. Within the known larvae there is considerable variation in the number of antennal segments in different instars, in the development of lateral abdominal flaps and, at least within the Australian species, in the form of the integument coverage. Somewhat unusually for Hydrophilidae larvae, it appears that specific differences are sufficient to enable the larvae of many species to be identified.

In the lack of lateral abdominal flaps and its four segmented antennae, *H. bilineatus* most closely resembles the North American *H. triangularis* but differs in a number of details, most obviously in the more robust mandibles with a well-developed molar region. The other Australian species appear more distant, particularly in the well-developed abdominal flaps and number of antennal segments. With the more robust mandibles and abdominal flaps these Australian species appear to be closer to the subgenus *Diblocelus* (sensu Hansen 1991) than subgenus *Hydrophilus* (Archangelsky 1997). On adult characters they fit clearly into the subgenus *Hydrophilus*.

Egg cases of several species were collected in the field and each produced between 15 and 30 larvae. Those thought to be of *H. bilineatus* refused all food offered but the other species accepted, often with some excitement, small snails and some accepted freshly killed mosquito larvae. None accepted chironomid larvae. Unfortunately, despite seemingly accepting snails as food, none was reared to the second instar. Species varied in the degree of cannibalism. Some broods were quite strongly cannibalistic but in others, apart from the occasional unfortunate individual, siblings lived well together.

Specimens of *Hydrophilus bilineatus* (MacLeay) have previously been identified as *H. picicornis* Chevrolat (Hansen 1999).

Specimens examined

Northern Territory: Manton Dam, 23/3/97; 2 km S Adelaide River 1/2/99.

Hydrophilus sp. **Northern Territory:** Newry Station, 2/86 col. M. J. Tyler. **Queensland:** 25 km S Townsville, 3/5/98, 2/2/97; 8 km S Greenvale, 27/3/96; 5 km NE Mt Molloy, 30/3/96. **South Australia:** 10 km N Coonawarra, 10/11/97, 16/10/97; 1 km S Nangwarra, 9/10/97. **Tasmania:** 12 km N Hobart, 2/12/00; 2 km W Fingle, 23/1/00; 3 km SW Clifton Beach, 4/12/00. **Victoria:** 5 km NE Dartmoor, 11/10/97. **Western Australia:** Murchison River, 13/3/95, col. S. Halse; 6 km S Pinjarrah, 23/10/96.

Laccobius Erichson

Laccobius decipiens Gentili. Fig. 13

Size of third instar. Length 5.0–6.5 mm; head capsule 0.43–0.50 mm long, 0.45–0.46 mm wide.

Head capsule. Subrectangular. Labroclypeus strongly asymmetrical; nasale prominent, with three teeth; lateral lobes of epistome asymmetrical, both projecting further than nasale; left lobe larger, covering basal third of mandible, with a row of about 12 strong curved setae on inner margin, larger ones dentate; right lobe smaller, covering a quarter of mandible, without setae. Frontal sulci parallel, reaching occipital foramen without coming together, difficult to see in third instar larvae. Coronal sulcus absent. Gular sclerite absent; cervical sclerites small and oval, difficult to see in first instar larva.

Antenna. Three-segmented; second segment the longest, with a small outer sensory appendage about a quarter the length of third segment; first segment half the length (first instar larvae) to slightly shorter (third instar larvae) than second segment.

Mandibles. Strongly asymmetrical. Left mandible with three inner teeth, central one largest, with five strong spines, region behind third tooth with a number of very short spines; right mandible with two inner teeth, larger than those of left mandible, front one much larger, occasionally also with a very small third tooth, or spine, behind the second.

Maxillae. Five-segmented. Stipes wide, longer than remaining segments combined, inner margin with four setae. Palpus four-segmented; first segment subquadrate, incompletely sclerotised, with a small inner process; second segment shortest; third and fourth segments subequal in length.

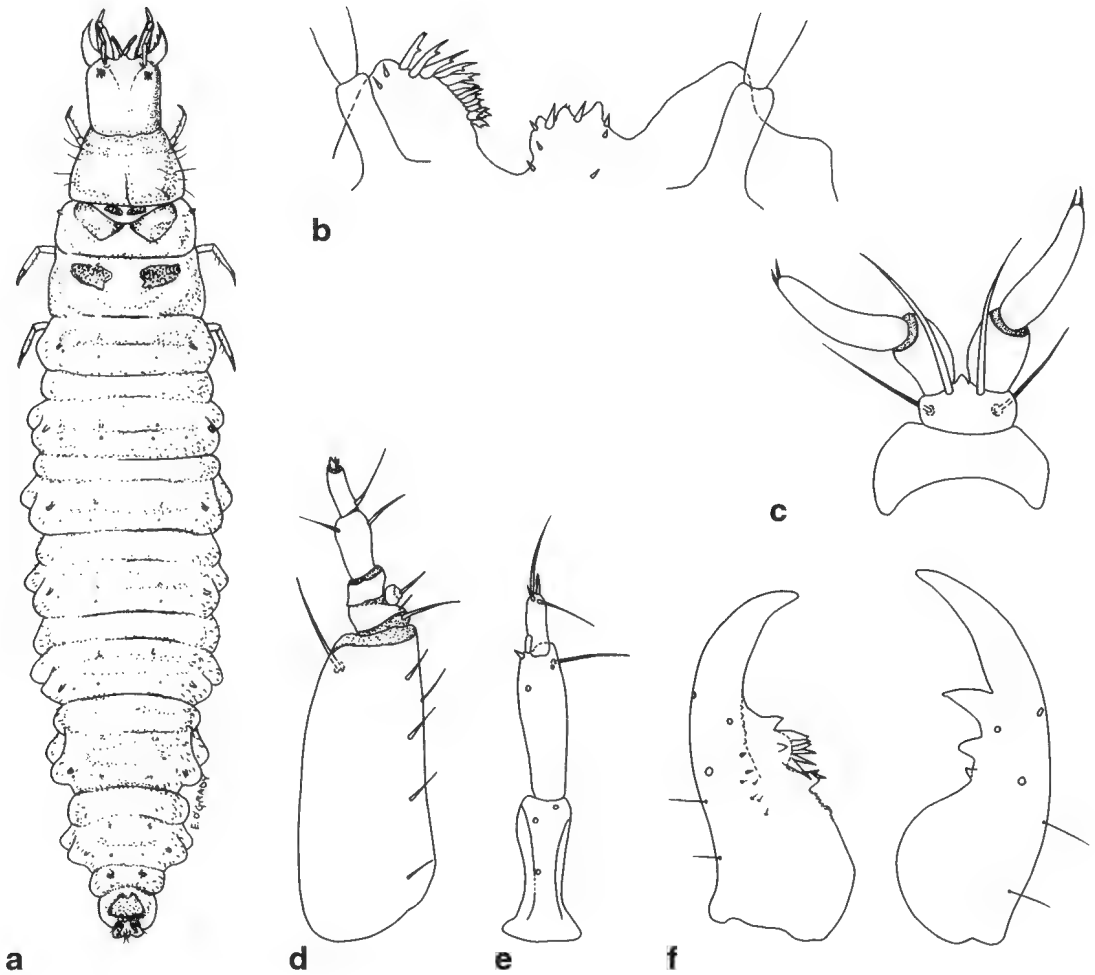


FIGURE 13. *Laccobius decipiens*. a, habitus; b, labroclypeus; c, labium; d, maxilla; e, antenna; f, mandibles.

Labium. Mentum small and narrow, subrectangular. Prémentum slightly larger, trapezoidal. Palpus two-segmented, first segment shorter, second segment two to three times longer than first. Ligula obsolete, at most reduced to a slight bulge.

Thorax and legs. Prothorax completely covered by a large dorsal sclerite, with sagittal line; ventrally with a pair of large subrectangular sclerites, fused in anterior half. Mesothorax with two pairs of dorsal sclerites, anterior one small, subrectangular; posterior pair larger, subtriangular. Metathorax with one pair of small, irregularly shaped sclerites intermediate in size to the two mesothoracic ones. Legs five-segmented, visible in dorsal view.

Abdomen. Segments 1 to 7 similar in shape, tapering towards posterior end, segments subdivided by transverse folds; sides with several slight bulges, each segment with a pair of long dorsal setae arising from small, darkly pigmented areas, one just behind spiracle and the other near midline. Segment 8 with a subtriangular dorsal sclerite. Segment 9 small, trilobed, bearing a pair of small one-segmented urogomphi. Integument with quite dense covering of short fine setae.

Spiracles. Nine pairs; one mesothoracic and eight abdominal. Mesothoracic and first seven abdominal spiracles non-functional, on short dark-pigmented papillae; spiracles on segment 8 annular, large and functional, within the spiracular atrium.

Intraspecific variation

Within specimens that I have identified as this species there is some variation as follows: some specimens have an additional small third tooth on the right mandible; in newly moulted specimens there are slight serrations on the upper mandibular teeth which appear to wear away quickly; the first abdominal segment occasionally has a pair of very small dorsal sclerites.

Interspecific variation

Within specimens unidentified to species there is variation in the shape of the dorsal sclerites on abdominal segment 8; the width of the nasale and the shape of the nasale teeth; the presence, size and position of abdominal sclerites. Overall these differences are slight.

Identification

By rearing larvae collected in the field.

Specimens examined

New South Wales: Bombala, 28/11/98; ditto, 4/11/97; ditto, 18/1/97. **Victoria:** Stratford, 7/11/97.

Laccobius spp. **Queensland:** Kauri Creek near Tinarro Dam, 24/10/93, col. D. Larson.

Remarks

There is little difference between the larvae of the Australian species and those of the North American *L. minutoides* Orchymont and *L. agilis* (Randall) described and illustrated by Richmond (1920) and Archangelsky (1997).

Limnoxenus Motschulsky*Limnoxenus zealandicus* (Broun). Fig. 14

Size of third instar. Length 11.5–15.0 mm; head capsule 1.60–1.79 mm long, 1.62–2.00 mm wide.

Head capsule. Square. Labroclypeus slightly asymmetrical; nasale moderately developed, angled slightly with right side more forward, with five teeth, left tooth a little distant from others; lateral lobes of epistome rounded, projecting not quite as far as nasale, right lobe often a little more rounded and a little more projected than left lobe. Frontal sulci U to V-shaped, fusing just before reaching occipital foramen. Coronal sulcus very short. Gular sclerite absent. Cervical sclerites relatively small, subrectangular.

Antennae. Three-segmented. First segment longer than remaining segments combined, with

some slender setae on distal two-thirds of inner margin; second segment about twice the length of third segment which is very thin. Sensory appendage on second segment minute.

Mandibles. Symmetrical with three inner teeth, progressively smaller towards base.

Maxillae. Five-segmented. Stipes stout, longer than remaining segments combined, with four long stout setae on inner margin. Palpus four-segmented; first segment the widest, with a short inner process; second and fourth segments short, subequal in length; third segment longest.

Labium. Mentum subrectangular, sides slightly concave, dorsal surface with small spines, anterolateral angles rounded, with several stout spines. Prementum square, not much smaller than mentum. Palpus two-segmented, first segment the shortest. Ligula present, slightly longer than first palpal segment, tip bifid.

Thorax and legs. Prothorax with large dorsal sclerite, with sagittal line; ventral surface with a large subrectangular sclerite, with sagittal line. Mesothorax with a pair of large triangular dorsal sclerites. Metathorax with a pair of wineglass-shaped dorsal sclerites sometimes with stem of wineglass absent. Rest of surface of thorax covered with very short spines, occasionally arranged in short rows. Legs five-segmented, relatively short, barely visible in dorsal view.

Abdomen. First segment with a dorsal pair of small subovoid sclerites close to anterior margin. Segments 1 to 6 similar in shape, tapering towards the caudal end; segments 7 and 8 more elongate and slender. Segments 1 to 7 subdivided into three transverse folds; dorsal surface of third fold with four small, dark, narrowly cylindrical tubercles; sides of each segment with three slight, fleshy bulges. Segment 8 with a large suboval dorsal sclerite, with three to four quite deep indentations on hind edge, lighter coloured towards middle. Segment 9 trilobed, with a pair of short one-segmented urogomphi. Integument densely covered with small setae and a sparse covering of longer setae which get progressively smaller posteriorly. Dorsal surface often with two darker stripes through sclerites and inner pair of tubercles.

Spiracles. Nine pairs; one mesothoracic and eight abdominal. Mesothoracic and first seven abdominal spiracles non-functional, on small papillae. Spiracles on segment 8 annular, large and functional, within the spiracular atrium.

Intraspecific variation

The number of nasale teeth is variable with up

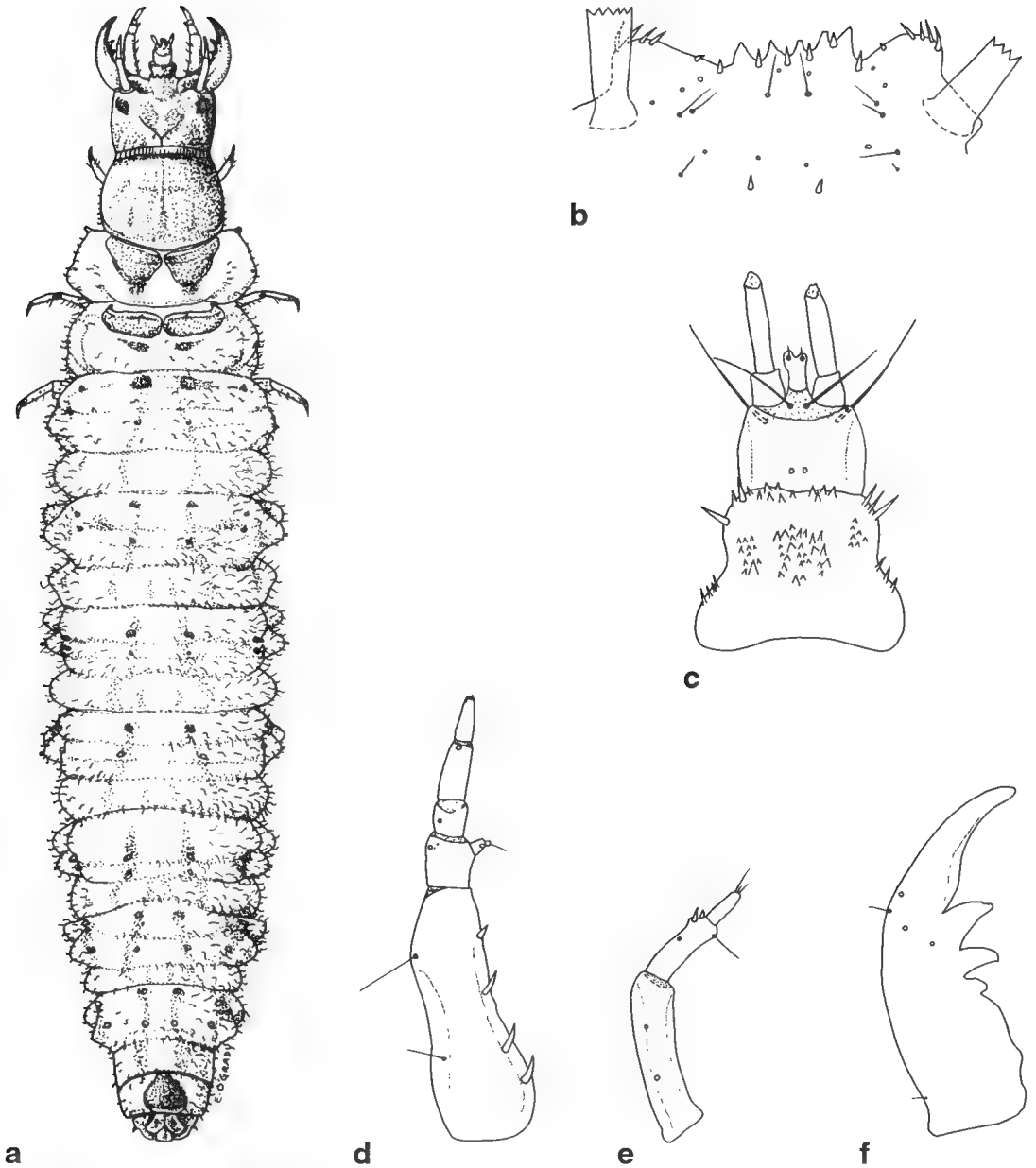


FIGURE 14. *Limnoxenus zealandicus*. a, habitus; b, labroclypeus; c, labium; d, maxilla; e, antenna; f, mandible.

to ten smaller teeth in some specimens; in some specimens these are worn down to the stage where the front of the nasale is almost smooth. The central nasale teeth are not well developed in first instar larvae. In one specimen the antennae are four segmented with the normal third segments clearly divided into two.

Identification

By rearing from larvae collected in the field.

Remarks

The larva of the European *L. niger* (Gimelin) has already been described by Berge Henegouwen (1975). The larva of the sole Australian and New

Zealand species differs little from those of this species.

One of the most commonly collected hydrophilid larvae in Australia, it is quickly recognised by the parallel darker stripes on the dorsal surface and combination of relatively short basal segment to the antenna and symmetrical three-toothed mandibles. The dense covering of small setae gives the abdomen a fur-like look.

Specimens examined

New South Wales: 10 km E Braidwood, 30/11/95; Braidwood, 19/1/97.

South Australia: 10 km N Coonawarra, 10/11/97; 10 km E Mt Compass, 13/9/97; Mt Crawford Forest, 10/11/96; 6 km N Forreton, 3/10/95; 19 km N Forreton, 3/9/99; 1 km S Nangwarry, 9/10/97; ditto, 29/8/99; 2 km S Penola, 20/11/99; Warburton River, 2–8/10/99, 27°52'23"S 137°54'40"E; Watervalley, 7.2 km NNE Mt Rough, 15/10/00. **Tasmania:** Lake St Clair, 4 km N Derwent Bridge, 25/1/00. **Victoria:** 5 km NE Dartmoor, 11/10/97; 2 km W Brimpaen, 23/9/98; Healsville, 12/68; 6 km N Noojee, 16/1/97. **Western Australia:** Gin Gin, 15/10/96; 10 km E Kalamunda, 16/10/96; 2 km W Nannup, 20/10/96; 6 km S Pinjarrah, 23/10/96; 1 km S Serpentine, 24/10/96; 10 km S Yallingup, 22/10/96.

Regimbartia Zaitzev

Regimbartia attenuata (Fabricius). Fig. 15

Size of third instar. Length 5.0–7.5 mm; head capsule 1.00–1.01 mm wide, 0.75–0.80 mm long.

Head capsule. Subquadrangular. Labroclypeus symmetrical; nasale very short, with numerous short teeth on anterior border of epistome; lateral lobes of epistome rounded, very short, not projecting as far as nasale, each with two long setae. Frontal sulci straight, short, meeting at about the level of the antennal bases. Coronal sulcus long, about half the length of the head capsule. Gular sclerite absent. Cervical sclerites small, subrectangular.

Antennae. Three-segmented. First segment slender, longer than other two combined, with a prominent subapical inner process some distance from apex. Sensory appendage on second segment slim, slightly shorter than third antennal segment.

Mandibles. Virtually symmetrical, long and slender, with two inner teeth on basal half; distal tooth large, basal one small.

Maxillae. Five-segmented. Stipes slender, much

longer than remaining segments combined, with four or five setae on inner margin. Palpus four-segmented; third segment longest; second segment shortest; first and fourth segments subequal in length, first segment with a short inner process.

Labium. Mentum large, wider than long, sides convex, dorsal surface with cuticular spines. Prementum elongate, much narrower than mentum. Palpus two-segmented, basal segment short. Ligula annular, two to three times as long as basal segment of palpus.

Thorax and legs. Prothorax with a large dorsal sclerite, with sagittal line; surface covered by minute spines; fringe of long, slender setae around the margins, four small spines, one on each anterolateral angle and two towards the middle; ventral surface with large, subrectangular sclerite, without sagittal line. Mesothorax with two dorsal pairs of subtriangular sclerites; metathorax with one dorsal pair of irregular shaped sclerites. Both mesothorax and metathorax with five pairs of setiferous projections, about half of them with a narrow cylindrical projection with a long seta attached at the end. Legs five-segmented, long, visible from above.

Abdomen. Segments 1 to 7 with five pairs of setiferous projections similar to those on thorax, four lateral ones with one more posterior than others and one closer to midline. In addition, the abdomen is covered with small stellate setae and the dorsal surface with small projections each with six to eight long, sharply pointed setae (in most specimens these structures are obscured by an accumulation of sand grains and detritus). Segment 8 without setiferous projections, with a pair of small finger-like 'procerci', with dorsal semispherical sclerite which covers the spiracular atrium. Segment 9 trilobed, with a pair of small, unsegmented urogomphi.

Spiracles. Nine pairs; one mesothoracic and eight abdominal. Mesothoracic and first seven abdominal spiracles non-functional. Spiracles on segment 8 annular, large and functional, within the spiracular atrium.

Interspecific variation

There is little variation between the few specimens seen.

Identification

By association of adults and larvae by isoenzyme electrophoresis.

Remarks

The larvae closely resemble both *Allocotocerus*

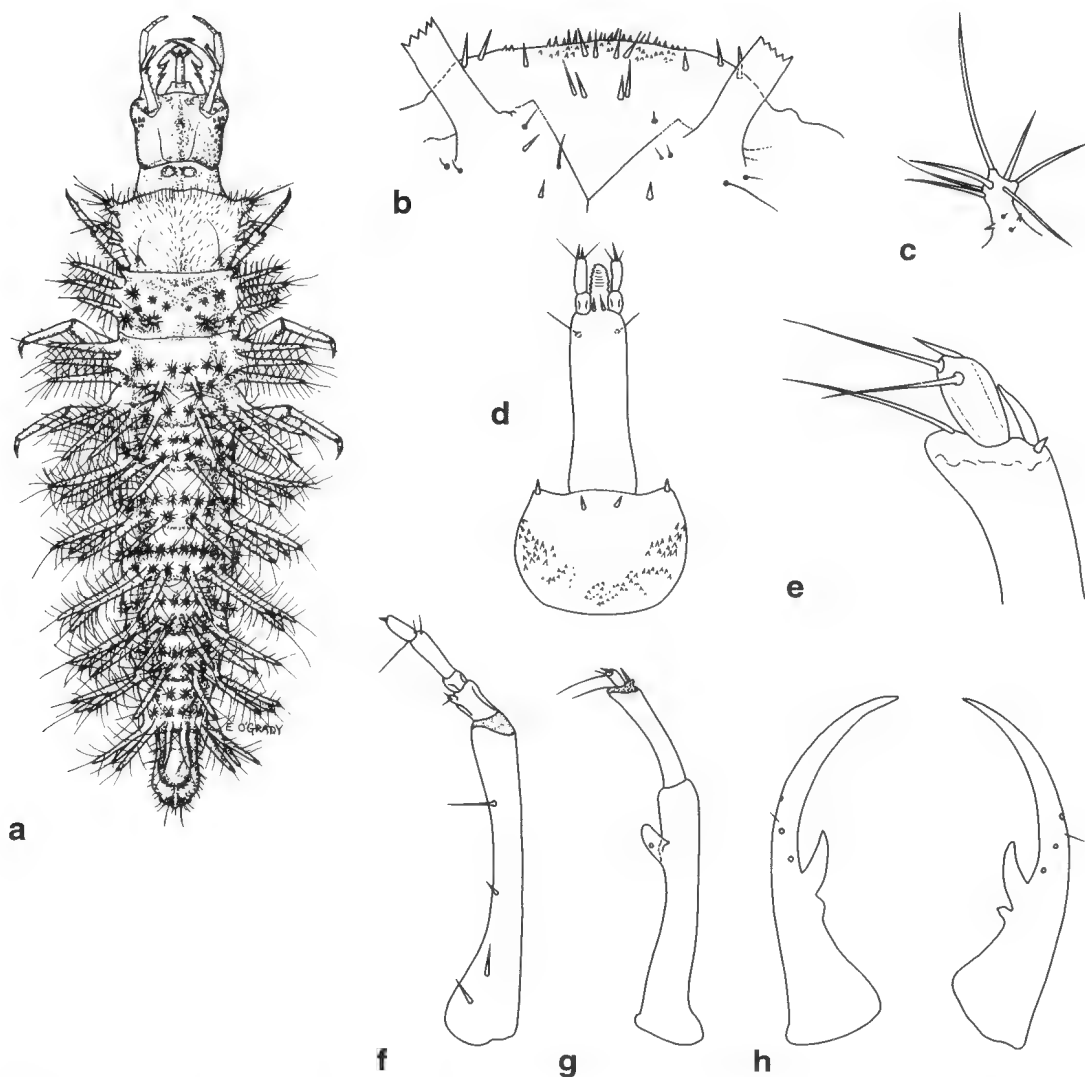


FIGURE 15. *Regimbartia attenuata*. a, habitus; b, labroclypeus; c, labium; d, detail of abdominal stella; e, tip of antenna; f, maxilla; g, antenna; h, mandibles.

and the New World *Derallus* (Archangelsky 1997; Spangler 1966), all three genera showing a suite of unusual characters that clearly separate them from other Hydrophilid larvae. The differences between the genera are relatively slight (see key and under *Allocotocerus*).

Specimens examined

Queensland: 6 km N Bluewater, 3/2/97; 15 km W Mareeba, 6/12/90, col. D. Larson; 5 km NW Mareeba, 22/9/90, col. D. Larson; 2 km N Mt Molloy, 1/4/96.

Sternolophus Solier

Sternolophus marginicollis (Hope). Fig. 16

Size of third instar. Length 11.5–15.0 mm; head capsule 1.80–1.90 mm long, 1.55–1.70 mm wide.

Head capsule. Subrectangular. Labroclypeus weakly asymmetrical; nasale short, weakly projecting with five short teeth, left one a little distant from rest; lateral lobes of epistome symmetrical not projecting beyond nasale, undulating. Frontal sulci V-shaped, fusing before

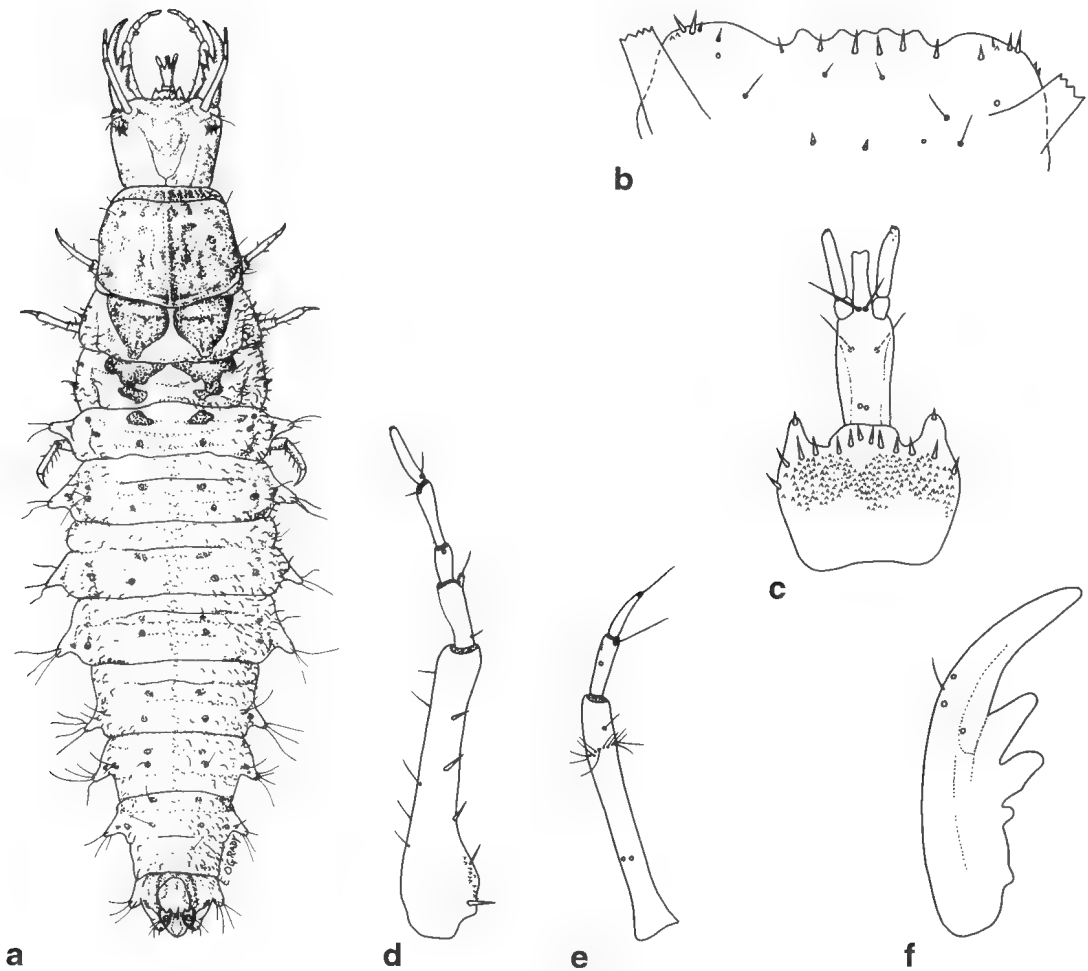


FIGURE 16. *Sternolophus* sp. a, habitus; b, labroclypeus; c, labium; d, maxilla; e, antenna; f, mandible.

reaching occipital foramen. Coronal sulcus short. Gular sclerite absent. Cervical sclerites small, suboval, longitudinally oriented. Frontal sulcus outlined in a darker colour.

Antennae. Three-segmented. First segment much longer than other two combined, with an annular ring of long setae near apex in second and third instars; second segment and third segment subequal. External apical appendage on second segment lacking; a small flat button-like structure on outside towards apex.

Mandibles. Virtually symmetrical, with three inner teeth, distal two large, basal one much smaller.

Maxillae. Five-segmented. Stipes as long (first instars) or longer (second and third instars) than

remaining segments combined, with four or five setae on inner margin and patch of small spines on inside near base. Palpus four-segmented; first segment with an inner apical process; second segment short; third and fourth segments a little shorter than first.

Labium. Mentum with sides convex, slightly wider than long, anterolateral corners pointed, dorsal surface with numerous small cuticular spines and row of longer spines towards apex; small spines mostly absent in first instar. Prementum long and thin. Palpus two-segmented, basal segment much shorter than distal. Ligula a little shorter than distal segment of palpus, slightly bifid at tip.

Thorax and legs. Prothorax with large dorsal

sclerite, with sagittal line, with pattern of darker lines and dots; ventral surface with a large subrectangular sclerite, with sagittal line. Mesothorax and metathorax each with a dorsal pair of subtriangular sclerites, smaller than those

of prothorax. Legs five-segmented, long, visible in dorsal view, with rows of long swimming-setae on femur and tibiotarsus.

Abdomen. Segments 1 to 6 similar in shape, tapering towards the caudal end; segments 7 and 8

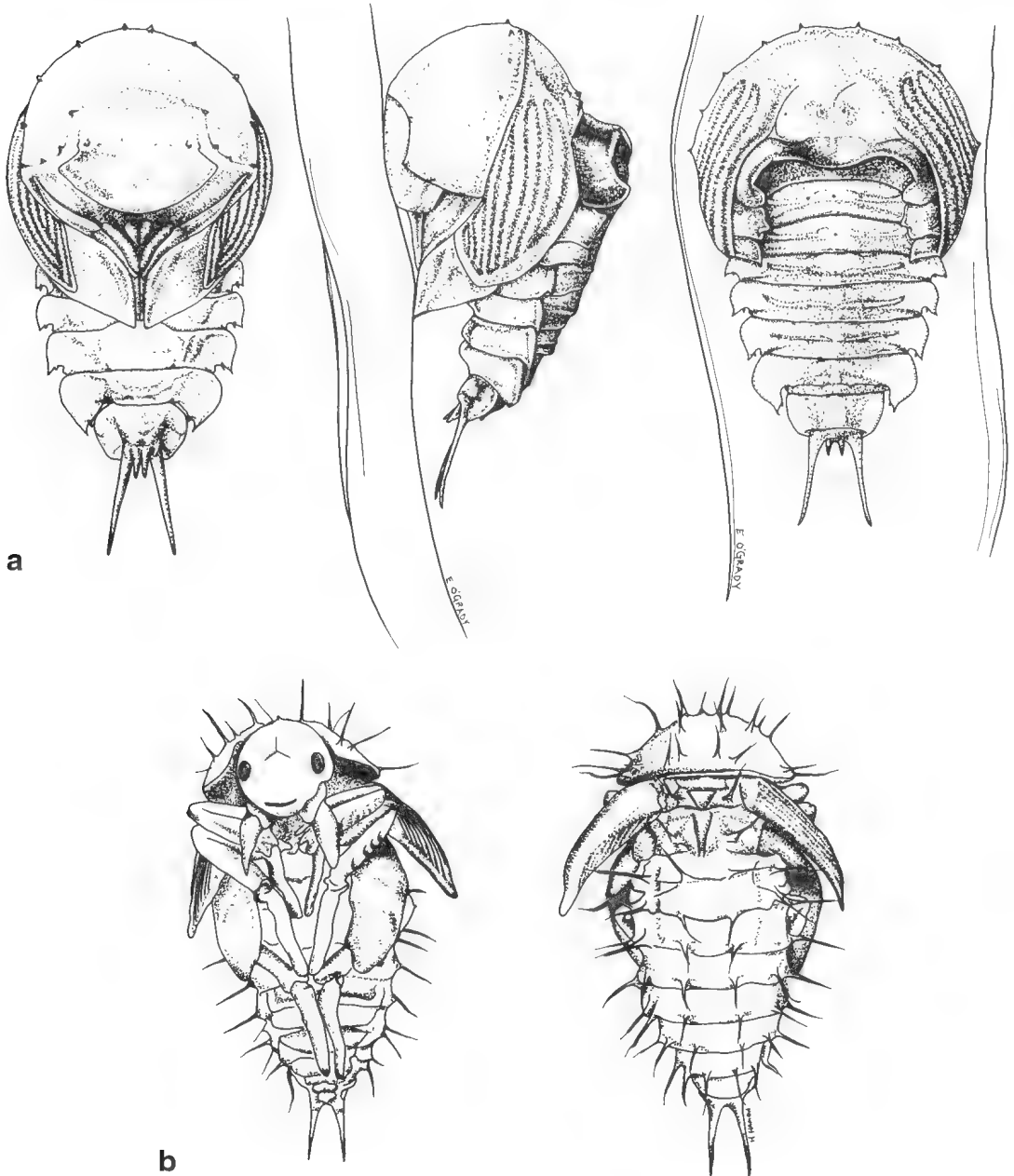


FIGURE 17. a, *Amphiops queenslandicus*: ventral, lateral and dorsal views of pupa. b, *Hybograllius hartmeyeri*: ventral and dorsal views of pupa.

more elongate and slender. Segments 1 to 7 subdivided into three transverse folds, each segment with transverse row of six pairs of long setae arising from short dark-pigmented cylindrical bases on dorsal surface of posterior fold. Pleura 1 to 8 each with a small, lateral, setiferous tubercle. Segment 8 with two small, dorsal, subtriangular sclerites at posterior end. Segment 9 slightly trilobed, with a pair of short one-segmented urogomphi. Integument densely covered with both very short and moderately long setae.

Spiracles. Nine pairs; one mesothoracic and eight abdominal. Mesothoracic and first seven abdominal spiracles non-functional. Spiracles on segment 8 annular, large and functional, within the spiracular atrium.

Intraspecific variation

There is some suggestion of two longitudinal dark lines on the dorsal surface in some specimens, and in an occasional specimen the small third mandibular tooth is virtually absent.

Interspecific variation

In some specimens of *Sternolophus* there is a greater development of the lateral abdominal tubercles into quite prominent finger-like projections, especially towards the rear; a row of setiferous papillae across the abdominal segments instead of small cylinder-like structures; a more symmetrical nasale; a stronger third mandibular tooth; and some difference in the shape of the meso and metathoracic sclerites (the habitus drawing (Fig. 16) is of this form). These larvae are *S. centralis* Watts and/or *S. immarginatus* Orchymont. The distribution of specimens would suggest the latter but not certainly so.

Identification

By rearing from field-collected larvae.

Remarks

The larva of *S. marginicollis* is one of the

few Australian larvae already known (Bertrand 1935) as *S. tenebricosus* Blackburn, a junior synonym (Watts 1989), although the identification was by association, which is unsafe in this genus because it often has two or more species common at the same locality. Other species have been described from Africa and Japan (see Bertrand 1972). The present larvae, certainly of *S. marginicollis* and probably also including *S. immarginatus* Orchymont, do not differ significantly from the published descriptions and illustrations.

Larvae of *Sternolophus* are commonly encountered in Northern Australia and can be readily separated from other Hydrophilid larvae by the combination of long thin prementum, long ligula and mandibles with three teeth.

Specimens examined

Northern Territory: Jabiru, 19/3/98; Manton Dam, 2/2/99; Ormiston Gorge, 27/1/99. **Queensland:** Killymoon Creek, 25 km S Townsville, 2/2/97.

Sternolophus sp. **Northern Territory:** Holmes Jungle near Darwin, 28/1/99. **Queensland:** 8 km N Bluewater, 31/10/95; Bohle River, 10 km N Townsville, 23/3/96; Eubenangee Swamp, 4/2/97; 2 km S Mt Molloy, 30/3/96.

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